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YELLOW WATER DAM

MANUAL FOR OPERATION AND MAINTENANCE

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Helena, MT 59620-1601**

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PROJECT DESCRIPTION

OVERVIEW

Yellow Water Reservoir is located in Petroleum County approximately eight miles southwest of the town of Winnett, Montana (and about six miles west of Highway 244). It is located on and fed by Yellow Water Creek and Snoose Creek. See Figures 1 and 2. Figure 3 provides a general layout of the dam, spillway and outlet works.

The dam is owned by the Montana Department of Natural Resources and Conservation (DNRC) and managed by the State Water Projects Bureau (SWPB) of the DNRC. The Yellow Water Water Users Association (herein called the “association”) operates and maintains the dam.

Water from the reservoir is primarily used for irrigation water supply. The reservoir also is used for water-based recreation.

EMBANKMENT

The earthfill dam and dike were completed in 1938. The dam is 37 feet high and 1,695 feet long, while the dike is 11 feet high and 545 feet long. In 1970, a riprap facing and gravel filter blanket were designed by the Soil Conservation Service for the upstream slope of the embankment.

OUTLET WORKS

The outlet works consist of a concrete intake structure, a 42-inch diameter reinforced concrete conduit, a wet well control tower, an outlet structure, and an irrigation water delivery canal. The wet well control tower contains a 42-inch diameter slide operating gate, flashboard guides and a ladder. The opening at the top of the

control tower is protected with a metal cover. The gate operating mechanism is located at the dam crest on top of the tower, and is operated manually with a hand crank.

Water released from the reservoir is conveyed downstream by a canal. There is a canal gate approximately 200 feet down the irrigation canal, that when opened, the water will flow into Yellow Water Creek.

The original outlet conduit was a corrugated metal pipe. The deteriorated pipe was replaced in 1985 with a 42-inch-diameter reinforced concrete pipe. The construction was done in two phases. Phase I was the excavation of the embankment and removal of the old pipe. Phase II consisted of installing the 42-in concrete pipe, constructing new inlet and outlet structures, cleaning the outlet gate, replacing the embankment, placing riprap on the upstream face of the dam, and seeding the disturbed area. The total cost, including the engineering design, field construction inspection, and both phases of construction, was \$200,000.

SPILLWAY

The spillway for the dam is located to the right (south) of the dam embankment between two dike sections. The spillway channel was relocated in the spring of 1979 as a corrective measure for localized erosion. Its entrance occupies approximately the same position as the old spillway, but then aligns in a north-south direction.

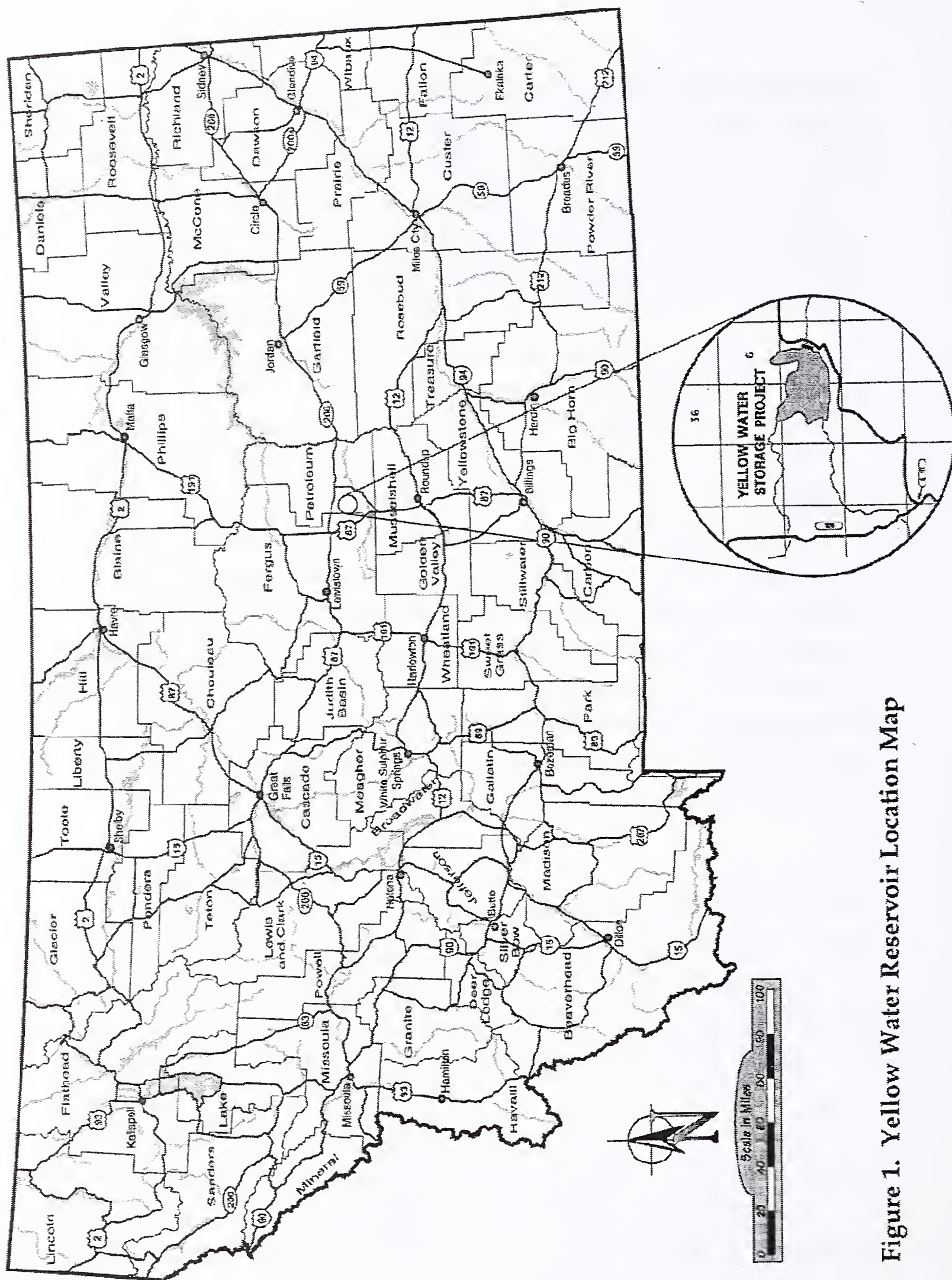
The spillway is an earthen, broad-crested, uncontrolled outflow system. The channel is trapezoidal in shape with a minimum base width of 95 feet and has approximate side slopes of 4h:1v. The spillway channel is contained by a natural ground floor, an old dike section on the right (east) side, and a new dike section on the left (west) side. The channel was excavated a short distance

into sandy shale material, which should reduce the erosion potential along the flow line. The channel extends approximately 500 feet on nearly a horizontal slope from the inlet to a point where the channel transitions to natural terrain. From there, the spillway discharge travels primarily as overland flow until returning to the Yellow Water Creek channel and flood plain.

The spillway capacity at elevation 3,123.84 feet is 3,900 cfs. The spillway rating table is in Appendix A.

DRAINS

A rock toe drain runs along the southern two-thirds of the dam. The drain system is located at the base of the pervious fill section for controlled collection and discharge of seepage water to the pervious rock toe. The drain runs parallel to the dam axis. The drawings for the dam show that the rock toe drain is connected to the internal toe drain by a number of lateral gravel connector drains which are perpendicular to the axis. Seepage from the drain flows into the pond located about 100 feet downstream from the dam.



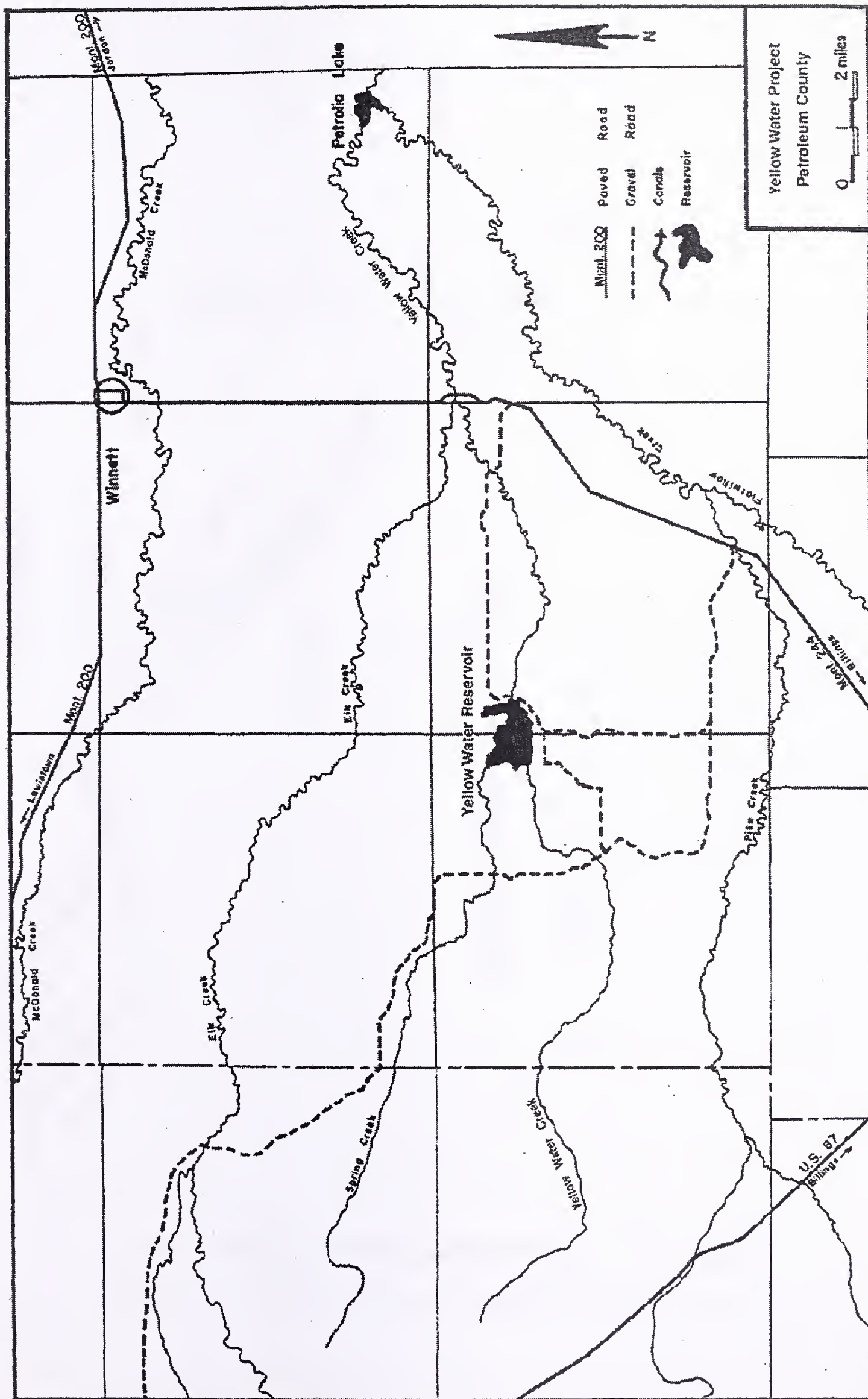


Figure 2. Yellow Water Project Map

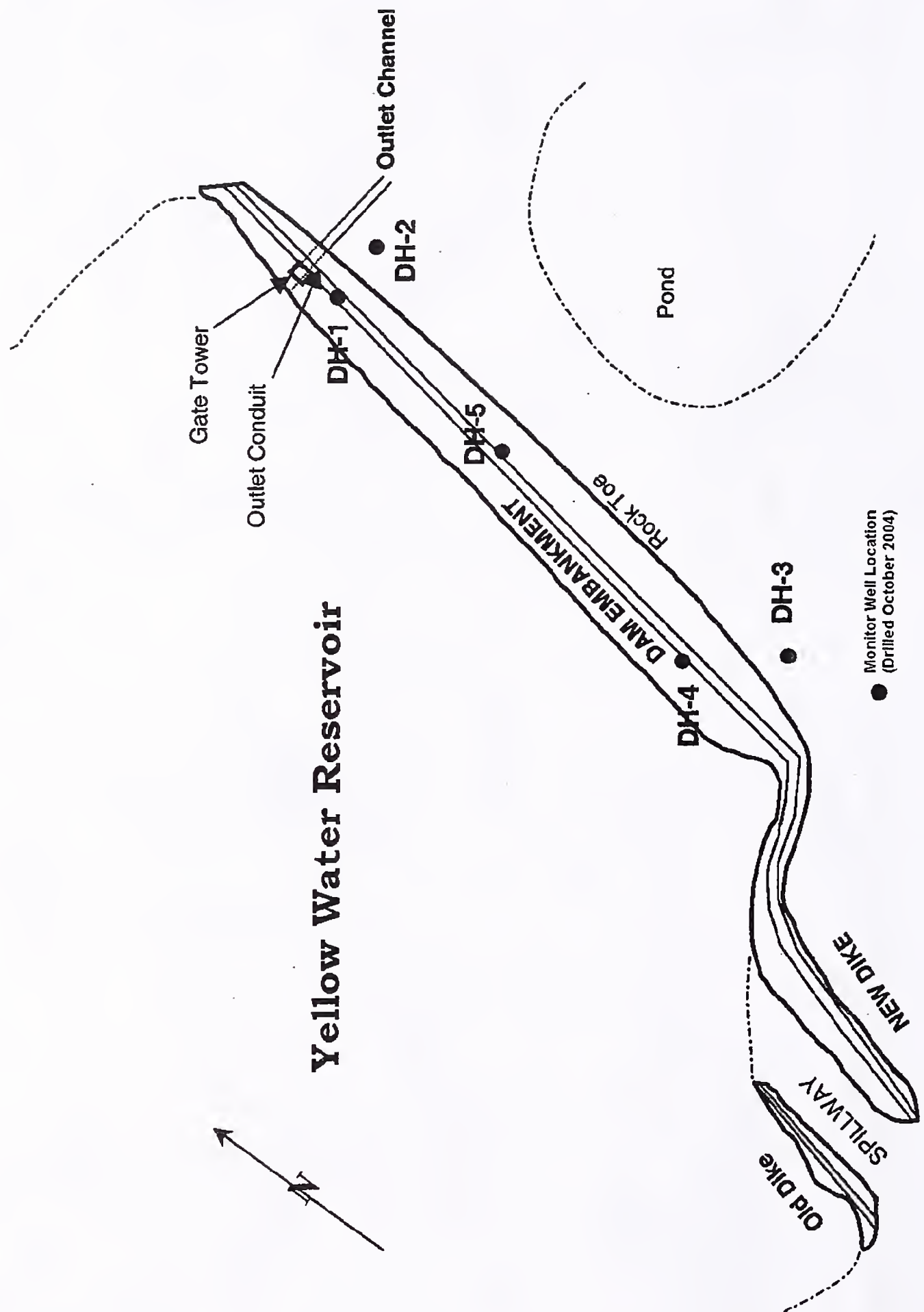


Figure 3. Yellow Water Dam General Layout

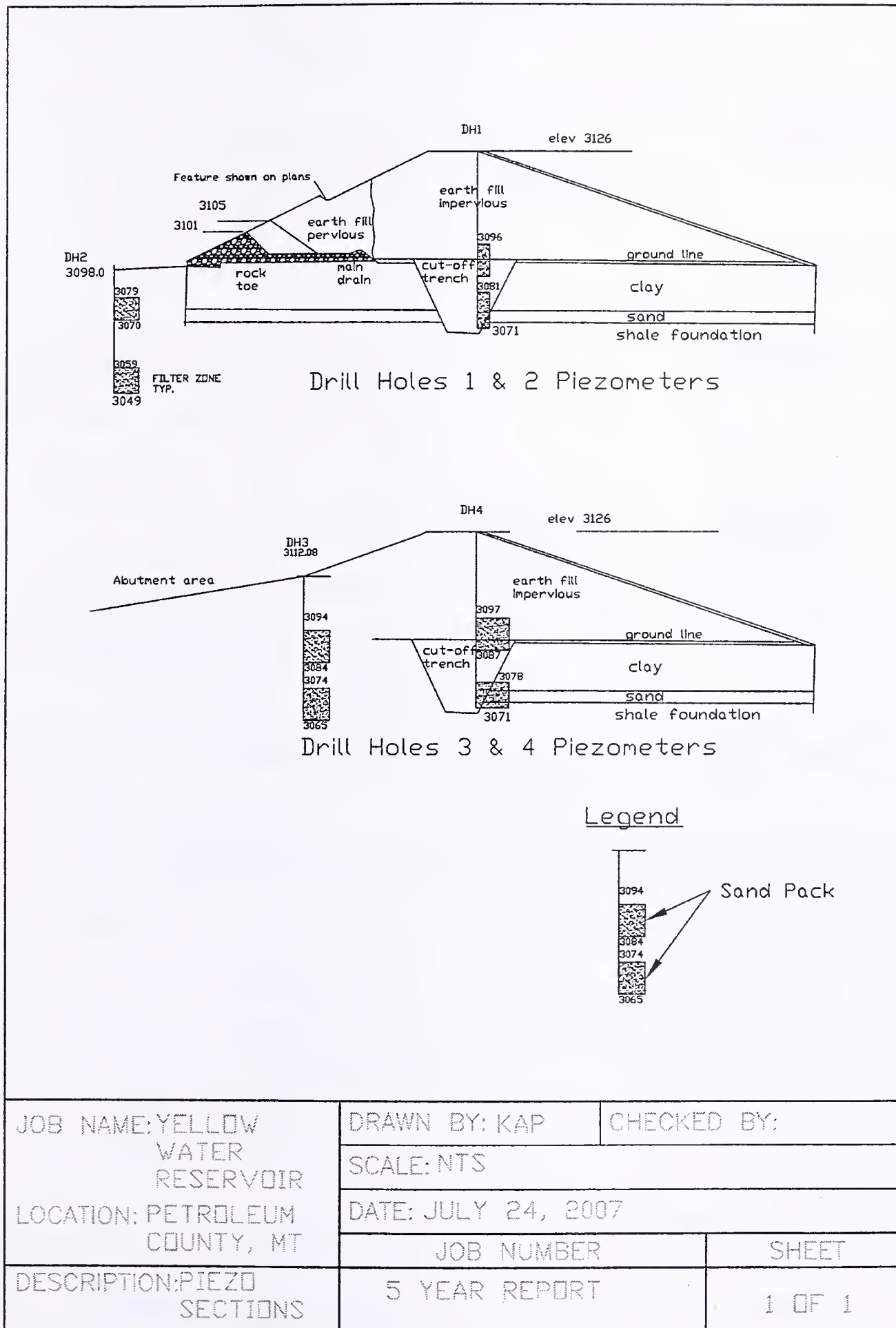


Figure 4. Yellow Water Dam Cross Section

STATISTICAL INFORMATION

1. General

a. Owner	Montana Department of Natural Resources and Conservation (DNRC)
b. Operator	Yellow Water Water Users Association
c. Location	Section 7, Township 13 North, Range 26 East and Section 12, Township 13 North, Range 25 East
d. Latitude	46.91°
Longitude	108.47°
e. County--State	Petroleum—Montana
f. Watershed Location	Yellow Water Creek-Flatwillow Creek-Musselshell River, Missouri River basin
g. Drainage Area	55 square miles

2. Principal Elevations (feet above mean sea level)

a. Maximum Dam Crest	3,126.5 feet
b. Top Outlet Works Tower	3,125.0 feet
c. Minimum Dam Crest	3,124.8 feet
d. Normal Full Pool	3,118.6 feet
e. Spillway Crest	3,118.6 feet

3. Reservoir

a. Length of Maximum Pool (approximate)	1.5 miles
b. Maximum Reservoir Level of Record	3,119.0 feet, estimated (before spring 1979)
c. Surface Area (at normal full pool)	490 acres

4. Storage

- | | |
|--|-----------------|
| a. Maximum Pool
(pool at dam crest) | 6,603 acre-feet |
| a. Total Storage
(pool at spillway crest) | 3,842 acre-feet |
| b. Active Storage
(total storage minus
dead storage) | 3,835 acre-feet |
| c. Dead Storage
(pool at invert of
Intake structure) | 7.0 acre-feet |

5. Hydrology

- | | |
|----------------------------------|-----------|
| a. 100-Year Flood | 2,288 cfs |
| b. 500-Year Flood | 4,587 cfs |
| c. 0.3 Probable
Maximum Flood | 9,168 cfs |

6. Embankment (Dam)

- | | |
|---|------------|
| a. Type | Earthfill |
| b. Hydraulic Height | 37 feet |
| c. Crest Length | 1,695 feet |
| d. Crest Width | 14 feet |
| e. Downstream Slope | 1v on 2h |
| f. Upstream Slope
(above Elev. 3,113.5 feet) | 1v on 2h |
| g. Upstream Slope
(below Elev. 3,113.5 feet) | 1v on 3h |

7. Embankment (Dike)

- | | |
|---------------------|-------------------------------|
| a. Type | Earthfill |
| b. Hydraulic Height | 11 feet |
| c. Crest Length | 545 feet |
| d. Crest Width | 20 feet |
| e. Downstream Slope | Varies from 1v on 2h to 1v on |

	4h
f. Upstream Slope	Varies from 1v on 2h to 1v on 4h

8. Spillway

a. Control	None
b. Crest Elevation	3,118.6 feet
c. Capacity (at pool Elev. 3,125.0 feet)	3,900 cfs

9. Outlet Works

a. Size	42-inch diameter reinforced concrete pipe
b. Length	150 feet
c. Control	One 42-inch diameter slide gate valve with manual operator
d. Capacity (at pool Elev. 3,125.0 feet)	192 cfs
e. Design Invert Elevation	3,094.22 feet
f. Top of Tower	3,125.0 feet
g. Trashrack	Yes

10. Brief History

a. The Yellow Water project was designed by the State Water Conservation Board (SWCB) in 1934 with construction starting December 4, 1935 and completed June 1938. It was constructed by the Civilian Conservation Service with SWCB oversight. The project lay dormant until 1947. This water impoundment structure was placed based on agricultural and economic needs.

b. In 1979, the original spillway was eroding and starting to threaten the embankment. A new spillway was configured running parallel to the embankment utilizing the original spillway entrance. This new alignment was reported to have a few areas of negative grade thus reducing its capacity.

c. In 1980 the USACOE funded a Dam Inspection; HKM Associates performed said inspection and condemned the outlet as it was in danger of failure due to corrosion of the original CMP. In 1984, the SWP hired Morrison Maeirle of Helena, Montana to design a new conduit and terminal outlet structure and in 1985 it was replaced with the present outlet structure.

d. In 2004 the SWP installed 5 wells each with deep and shallow piezometers. Since that time the water impoundment structure has not filled.

OPERATING PROCEDURES

The association manages Yellow Water Dam to insure safe operation of the project and to provide an adequate supply of irrigation water to meet contracts with water users without exceeding safe storage or flow levels.

DAM OPERATOR

The responsibility for the daily operation of the dam and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing an adequate supply of water when called for by the association members. Specific responsibilities of the dam operator are as follows:

1. Operate the mechanical features of the outlet works
2. Coordinate filling of the reservoir and the release of water
3. Notify the SWPB of unusual occurrences such as impending floods or excessive seepage.
4. Perform certain maintenance tasks.
5. Monitor weather conditions.
6. Monitor seepage.

Typically, the out-going dam operator, the water users association, and the SWPB train a new dam operator. The dam operator's training focuses on the mechanical operation of the gate, measurement of the storage level, measurement of the rate of water release, daily observation of unusual conditions, and record keeping.

The dam operator normally is available to observe the dam and perform operating functions daily during the times of rapid reservoir filling. During the remainder of the filling and irrigation season, the operator is at the dam three to five times per week.

During the non-irrigation season, the dam operator or one of the directors observe and regulate the dam on a monthly basis.

Communication among the dam operator, the association, and the SWPB usually takes place by telephone. Radio communication may be established during emergencies or unusual occurrences so that the dam operator can speak directly with county authorities and with the SWPB (**see *Yellowwater Dam Emergency Plan***).

METHOD AND SCHEDULE OF OPERATION

The association's goal is to have the reservoir full before contract holders start putting in calls for water. The beginning date of irrigation releases varies from year to year, with mid-April being the earliest month during which irrigation releases begin. The last irrigation releases typically are made by September 1. All dates tend to vary depending on a year's actual climatological and hydrological conditions.

Maximum Winter Storage: The maximum winter storage is 3,116 feet with 2,943 acre-feet of storage. This winter maximum helps prevent damage to the riprap and embankment from wind-driven waves and ice.

Minimum Water Storage: The minimum winter storage is 3,101.7 feet with 207 acre-feet of storage. This winter minimum helps prevent ice damage to the inlet structure for the outlet works, minimizes water quality problems, and helps to maintain the fishery.

GATE OPERATION

The maximum amount the operating gate may be opened is 42 inches. An opening in excess of this amount may damage the gate, gate frame, gate stem or the gate pedestal. The gate opening is measured on the exposed portion of the gate stem between the top of the pedestal and the bottom of the stop nut (or top of the gate stem if there is no stop nut).

Water released from the reservoir is conveyed downstream by a canal. The maximum capacity of the canal without overtopping the canal banks is approximately 45 cfs. If the outlet works are operated far in excess of the delivery canal's capacity, the canal and structures may be damaged.

With the reservoir pool at the dam crest, the capacity of the outlet works is 192 cfs. An outlet rating table is in Appendix A. The outlet works are intended to be used for controlling the release of irrigation water and not for providing emergency relief.

SAFE DRAWDOWN

Since the stability of Yellow Water Dam has not been thoroughly investigated, drawdown rates are recommended not to exceed one foot per day.

STORAGE DETERMINATION

If water is not being diverted, storage and reservoir surface elevation can be determined by measuring from the top of the control tower to the water surface in the tower. The top of the control tower is at elevation 3,125.0 feet. Subtract the vertical distance to the water surface from 3,125.0 to find the elevation of the water surface. Once the reservoir surface elevation is determined, the reservoir storage is found using the Storage-Elevation Table (Table 1) in Appendix A.

If water is being diverted, the water surface in the control tower will be lower due to drawdown from the open operating gate. An accurate vertical distance to the water surface cannot be obtained.

INFLOW AND OUTFLOW MONITORING

There are no stream gages upstream or downstream of Yellow Water Dam.

WEATHER MONITORING

The dam operator monitors weather conditions through local weather forecast and the National Weather Service (NWS).

If severe flooding is anticipated, the NWS Glasgow Office **(1-406-228-9622 or 1-406-228-2850)** should be contacted for information about the storm, such as the estimated storm intensity and duration, runoff duration (above base flow), and total flood volume of the storm in the Yellow Water Creek drainage.

INTERACTION WITH OTHER DAMS

Other than irrigation diversion dams, there are only two dams located below Yellow Water Reservoir (at least within the boundaries of Montana). Petrolia Dam is 22.2 river miles downstream, and Fort Peck Dam is further downstream on the Missouri River.

Yellow Water Reservoir is the only storage facility of size upstream of Petrolia Dam. The safety of Petrolia Dam is not generally a concern during the normal operation of Yellow Water Reservoir. The amount of water that can be released by Yellow Water Reservoir can easily be handled by Petrolia.

The safety of Fort Peck Dam is not affected by the operation of Yellow Water Reservoir during either normal or emergency operations.

EMERGENCY

If it appears that the dam or dike at Yellow Water is about to breach, or during emergency operations, the dam operator will initiate the **Yellow Water Dam Emergency Action Plan**.

INSPECTION AND MONITORING

Annual inspections are conducted by the SWPB. Appendix B includes an example of SWPB inspection report form. In addition to annual inspection, SWPB personnel will inspect the dam and reservoir during and after heavy runoff and severe rainstorms and windstorms, during high storage periods, and after an earthquake.

STRUCTURAL FEATURES INSPECTION

Structural features include the wet well, spillway, outlet works, and canal headgate. The SWPB inspects these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to:

1. Outlet Works
 - a. Any differential settlement or movement resulting in cracking of the conduit
 - b. Erosion of the seals or concrete by cavitation immediately downstream of the gate
 - c. Seepage of water into or along the conduit
 - d. Deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
 - e. Operation of the gate
 - f. Air vent free and unobstructed operation
 - g. Corrosion of any metal
 - h. Proper lubrication and cleaning of gate pedestal
2. Wet Well-Any damage or vandalism
3. Spillway
 - a. Erosion sides and bottom
 - b. Accumulation of debris or sediment
4. Embankment
 - a. Erosion gullies in dam and dike face
 - b. Damage from burrowing animals or vegetation

c. Displacement or loss of rip-rap protection

d. Displacement of fill, sink holes, or slumps

It is important to note settlement or slumping in the area above the outlet pipe which was disturbed when the outlet conduit was replaced in 1985.

e. Any seepage.

RIPRAP INSPECTION

The riprap along the face of the dam and dike should measure at least 24 inches thick. Immediately after the occurrence of high water, the riprap should be inspected and additional riprap added if needed.

EMBANKMENT MONITORING POINTS

There are no monitoring measurement points on the dam embankment.

DRAINS

The drain system for the dam consists of an internal “main drain” constructed of select gravel, select gravel lateral drains, and a pit run gravel and rock toe drain along the middle 2/3rds of the dam. The main drain is located about 52 feet upstream from the downstream toe. There are a number of laterals that lead from the main drain to the rock filled toe or the edge of the embankment toe. During the reconstruction of the outlet works, the main drain was uncovered, but it was very hard to distinguish it from the embankment material.

Seepage has been observed exiting from a number of locations along the rock toe, which flows, into the seepage pond located below the dam. No estimate could be made of the past flow volume. In comparing past photos of the seepage area, the flow appears to increase when the reservoir’s pool elevation increases and decrease when the reservoir pool elevation decreases.

A filter drain was placed along the downstream 28 feet of the conduit during the outlet reconstruction. The filter consists of “select” pipe drain bedding gravel encased in a filter fabric. The filter drain exits into the outlet-stilling basin. There has been no observable flow from this drain since reconstruction was completed in 1985.

SEEPAGE

Right Abutment: Several seepage areas have been observed exiting from the rock outcrop along the south side of the pond located at the toe of the dam. The seepage flow appears to be passing through the bedrock formation which is laminated sandstone, and exiting below the right abutment embankment contact. At the embankment contact, free water has not been observed but is evidenced by the saturated soils and heavy vegetation. No flow measurements have been made, however total flow is estimated in the 2 to 3 gpm range.

Old Spillway: A similar condition exists below the old spillway area on the right abutment. No standing water has been observed in this area, but the soil is moist with green vegetation indicating that water is present. The seepage exits at a location where the bedrock is exposed about 150 to 300 feet below the spillway area.

Neither of these seepage conditions have apparently saturated the embankment materials nor is there evidence that they have significantly affected the foundation integrity.

Dam Embankment: Seepage water has been observed exiting from a number of locations along the rock toe drain. The seepage flows into the pond located about 100 feet downstream from the dam. No indication of sediment moving with the water has been observed.

Measuring the discharge from the toe drain with weirs or some other measuring device would be difficult due to the flat gradient between the exit location and the pond. Also, the pond receives water from the outlet, because the outlet canal flows through part of the pond.

Monitoring Wells

As part of the Outlet Conduit Investigation in 1982, a single open standpipe observation well was installed in the area of the outlet conduit along the downstream shoulder of the dam. This observation well was removed during the reconstruction of the outlet conduit in 1985 and not replaced.

In 2004 the SWP installed 5 wells each with deep and shallow piezometers. Three of the wells are located on the crest of the dam. Two more monitoring wells were drilled at the toe of the dam (See Figure 3). Each monitoring well has two standpipes. Soil profiles of the drill holes and well details are shown in appendix C. Levels in monitoring wells should be monitored monthly from May through September during years when the reservoir fills. However, the reservoir has not filled since the piezometers were installed. A minimum monitoring schedule during low water years shall include Spring and Fall, and monitoring on periodic site visits by the dam operator and SWP staff. Increased monitoring to monthly or more frequently will be determined by DNRC Lewistown Regional Office, and Helena Regional Office SWPB staff. Monitoring well measurements are primarily performed by the dam operator. The wells may also be measured by DNRC Lewistown Regional Office, and Helena Regional Office SWPB staff.

MAINTENANCE

The association is responsible for routine maintenance of the project. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection.

ROUTINE MAINTENANCE

To project the dam and keep it in good working order, the dam operator during regular visits to the dam will watch for and identify any potential maintenance requirements. As soon as a need is identified, the dam operator needs to schedule and perform the routing maintenance.

Items that may need occasional attention include, but are not limited to:

1. *Lubrication of gate-operating mechanism.*
2. *Debris or silt plugging the outlet channel or spillway.*
Accumulated debris that could affect the operation of these appurtenances should be removed at once, with all debris removed at least annually.
3. *Erosion gullies on embankment.* Development of erosion gullies should be checked immediately. Gullies should be filled, compacted, and seeded. Particular attention should be paid to the abutment contact areas and the downstream faces.
4. *Four wheel tracks:* Four-wheel driving on the downstream faces should not be allowed. If four-wheel drive tracks become evident; a fence should be placed along the base of the dam embankment.
5. *Rodent damage.* Rodent should be removed or destroyed and any burrow holes should be filled immediately.
6. *Upstream slope riprap.* The upstream face riprap will be observed annually, but may occasionally need repairs because of high water or wave action.

7. *Vegetative cover on downstream slopes.* Good vegetative cover will be maintained, but large brush or any trees will be removed.
8. *Noxious weeds.* Noxious weeds on and around the dam embankment and dikes, and around the reservoir, should be sprayed at least on an annual basis.
9. *Cleaning outlet wall tops.* Outlet wall tops should be clear of any dirt, rocks, grass, brush, and any overhanging vegetation.
10. *Concrete repair.* Any damage or spalling of the concrete on the gate tower or outlet walls should be repaired.
11. *Dam crest.* The dam crest should be graded periodically to remove ruts and restore grade.

ANNUAL MAINTENANCE

The SWPB conducts annual inspections of the Yellow Water Dam and reservoir. During these inspections, any items requiring annual maintenance will be identified and recorded. Items that may need annual maintenance include the outlet works, operating gate, riprap, and roads.

After the inspection, the SWPB sends the association a Dam Safety Inspection Report and a Maintenance Report. The reports identify items that need maintenance and provide a schedule of when the maintenance tasks need to be completed. The association is responsible for performing the maintenance items within the times specified.

The dam operator or association members may perform the maintenance items. However, major repairs will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

RECORD KEEPING

The SWPB maintains records, including photographs, of all inspections and maintenance requirements. Records are also maintained of the reservoir storage volume. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator keeps records of the reservoir elevation, seepage observation or measurements, and any unusual conditions. These records may be reviewed at the dam operator's home

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APPENDICES

APPENDIX A

RATING CURVES AND TABLES

TABLE 1. ACTIVE STORAGE IN ACRE-FEET**YELLOW WATER RESERVOIR**

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
3094						0	2	3	5	7
3095	8	10	12	14	15	17	19	21	22	24
3096	26	27	29	31	33	34	36	38	39	41
3097	43	45	46	48	50	52	53	55	57	58
3098	60	62	64	65	67	71	76	80	84	88
3099	93	97	101	105	110	114	118	122	127	131
3100	135	139	144	148	152	156	161	165	169	173
3101	178	182	186	190	195	199	203	207	212	216
3102	220	229	238	247	257	266	275	284	293	302
3103	312	321	330	339	348	357	366	376	385	394
3104	403	412	421	430	440	449	458	467	476	485
3105	495	504	513	522	531	540	549	559	568	577
3106	586	603	620	638	655	672	689	706	723	741
3107	758	775	792	809	826	844	861	878	895	912
3108	930	947	964	981	998	1,015	1,033	1,050	1,067	1,084
3109	1,101	1,118	1,136	1,153	1,170	1,187	1,204	1,221	1,239	1,256
3110	1,273	1,299	1,324	1,350	1,375	1,401	1,426	1,452	1,477	1,503
3111	1,528	1,554	1,579	1,605	1,630	1,656	1,681	1,707	1,732	1,758
3112	1,783	1,809	1,834	1,860	1,885	1,911	1,936	1,962	1,987	2,013
3113	2,038	2,064	2,089	2,115	2,140	2,166	2,191	2,217	2,242	2,268
3114	2,293	2,326	2,358	2,391	2,423	2,456	2,488	2,521	2,553	2,586
3115	2,618	2,651	2,683	2,716	2,748	2,781	2,813	2,846	2,878	2,911
3116	2,943	2,976	3,008	3,041	3,073	3,106	3,138	3,171	3,203	3,236
3117	3,268	3,301	3,333	3,366	3,398	3,431	3,463	3,496	3,528	3,561
3118	3,593	3,633	3,674	3,714	3,754	3,794	3,835	3,875	3,915	3,955
3119	3,996	4,036	4,076	4,116	4,157	4,197	4,237	4,277	4,318	4,358
3120	4,398	4,438	4,479	4,519	4,559	4,599	4,640	4,680	4,720	4,760
3121	4,801	4,841	4,881	4,921	4,962	5,002	5,042	5,082	5,123	5,163
3122	5,203	5,253	5,302	5,352	5,402	5,452	5,501	5,551	5,601	5,651
3123	5,700	5,750	5,800	5,850	5,899	5,949	5,999	6,049	6,098	6,148
3124	6,198	6,248	6,297	6,347	6,397	6,447	6,496	6,546	6,596	6,646
3125	6,695	6,745	6,795	6,845	6,894	6,944	6,994	7,044	7,093	7,143

Spillway crest elevation 3118.6 (old datum 992.6)

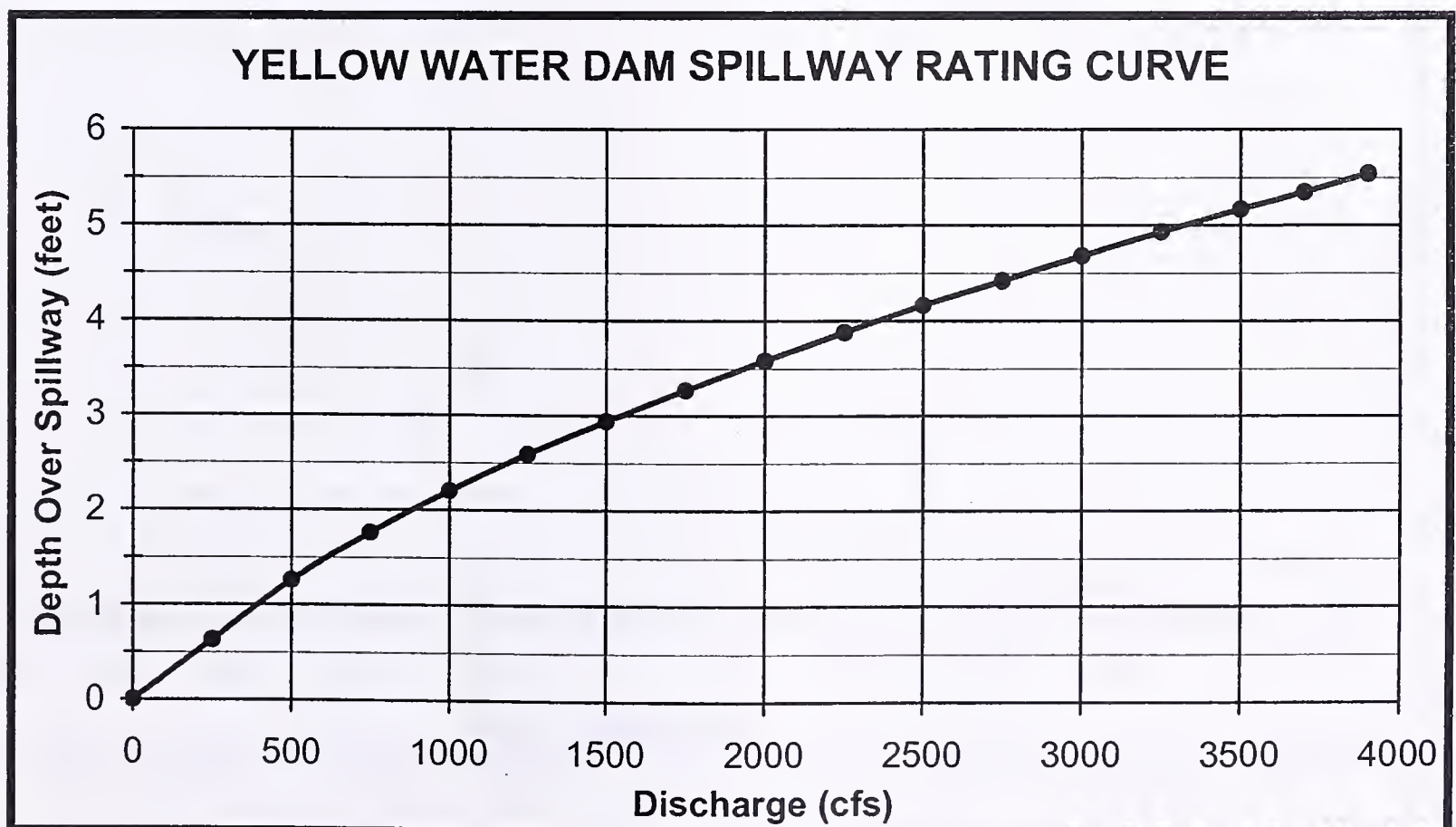
Top of tower elevtion 3125.0 (old datum 999.0)

NOTE: Storage table based on 1984 aerial photography and mapping of the reservoir.

TABLE 2. SPILLWAY DISCHARGE

YELLOW WATER DAM

Depth Over Crest (feet)	Elevation (feet)	Discharge (cfs)
0	3118.3	0
0.63	3118.93	250
1.26	3119.56	500
1.76	3120.06	750
2.2	3120.5	1000
2.59	3120.89	1250
2.94	3121.24	1500
3.27	3121.57	1750
3.58	3121.88	2000
3.88	3122.18	2250
4.16	3122.46	2500
4.42	3122.72	2750
4.68	3122.98	3000
4.93	3123.23	3250
5.17	3123.47	3500
5.35	3123.65	3700
5.54	3123.84	3900

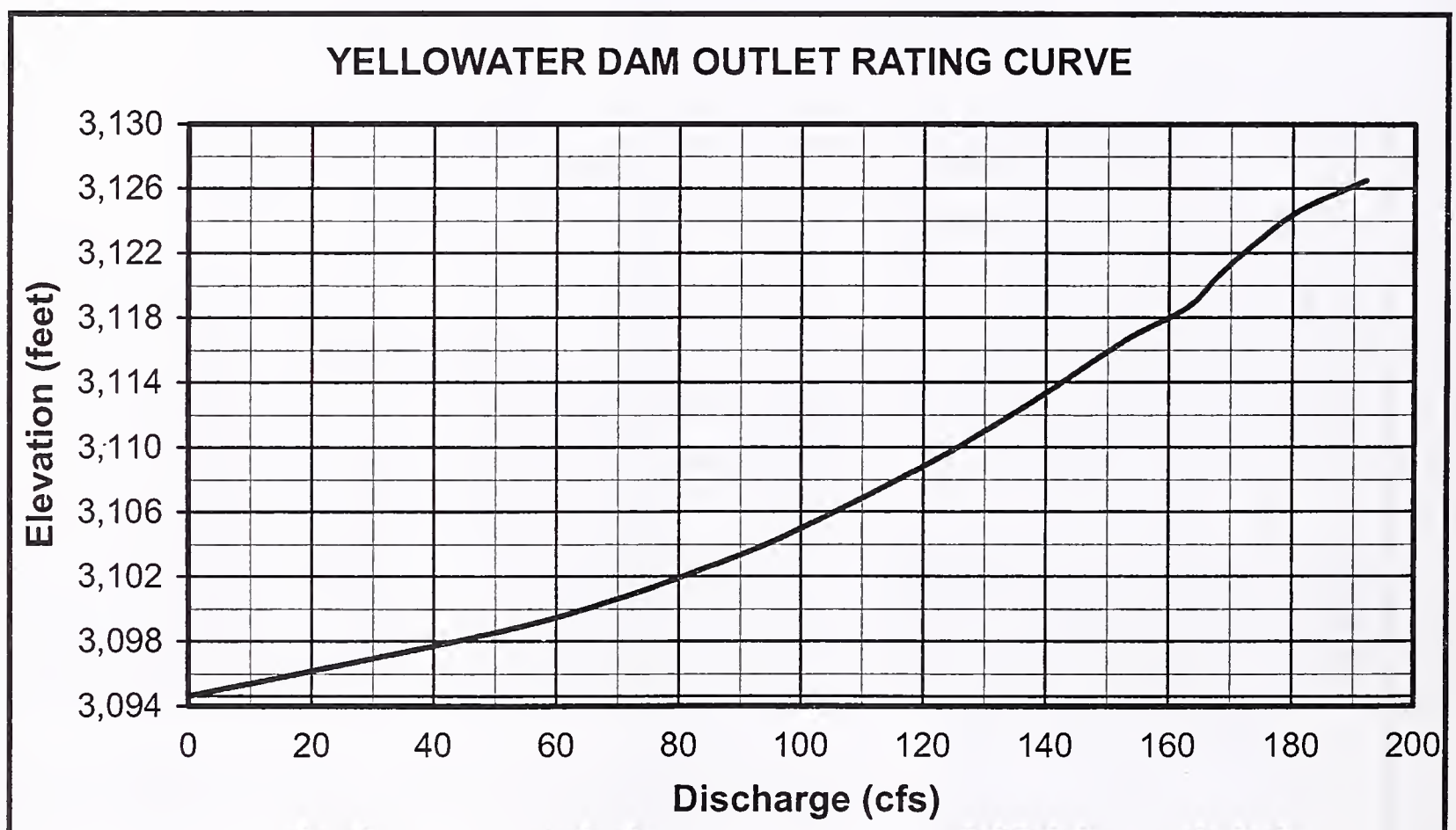


Note: Data From 2007 Yellow Water Five Year Inspection by Kenneth Phillips P.E .

TABLE 3. OUTLET DISCHARGE
YELLOW WATER RESERVOIR

Reservoir Elevation (feet)	Discharge** (cfs)	Comment
3,094.6	0	
3,098.6	51	
3,100.6	70	
3,102.6	85	
3,104.6	98	
3,108.6	119	
3,112.6	137	
3,116.6	153	
3,118.6	163	Spillway Crest
3,120.6	168	
3,122.6	174	
3,124.6	181	
3,126.5	192	Maximum Dam Crest

**Discharge assumes operating gate is in fully open position.



Note: Data from the Corps of Engineers Phase 1 Inspection Report (1980).

APPENDIX B
INSPECTION CHECKLIST

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM _____
DATE INSPECTED _____

INVENTORY NO. _____
HAZARD CATEGORY _____
TYPE OF DAM _____
YEAR BUILT _____

OWNER _____
OPERATOR _____
STREAM _____
DRAINAGE AREA _____

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_____	_____
At spillway crest	_____	_____
At min. dam crest elevation	_____	_____

ITEM	YES	NO	REMARKS
------	-----	----	---------

1. EMBANKMENT

A. Crest -- Height= Length= Width=

(1) Any visual settlements?			
(2) Any misalignments?			
(3) Any cracking?			
(4) Any traffic damage?			
(5) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

1. EMBANKMENT (continued)

B. Upstream Face -- Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Is riprap protection adequate?			
(5) Any stone deterioration?			
(6) Any visual settlement, slumps, sloughing, depressions or bulges?			
(7) Adequate grass cover?			
(8) Debris on the dam face?			
(9) Other?			

C. Downstream Face--Slope= 1V on 2H

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Any visual settlement, slumps, sloughing, depressions or bulges?			
(5) Is the toe drain dry?			
(6) Are the relief wells flowing?			
(7) Any boils at the toe?			
(8) Any seepage areas?			
(9) Any traffic or animal damage?			
(10) Any burrowing animals?			
(11) Adequate grass cover?			
(12) Other?			

D. Amount and Type of Vegetation on the Dam

--

ITEM	YES	NO	REMARKS
------	-----	----	---------

2. ABUTMENT CONTACTS

A) Any erosion?			
B) Any visual differential movement?			
C) Any cracks?			
D) Any seepage present?			
E) Other?			

3. OUTLET WORKS

A. Intake Structure -- Size=

(1) Any settlement?			
(2) Any tilting?			
(3) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(4) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(5) Metal appurtenances:			
a. Any corrosion present?			
b. Any breakage present?			
(6) Trash rack?			
a. Condition?			
b. Anchor system secure?			
(7) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

B. Conduit -- Type =

(1) Do concrete surfaces show: NA			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Is the conduit metal?			
a. Any corrosion present?			
b. Protective coatings adequate?			
(4) Is the conduit misaligned?			
(5) Any calcium deposits?			
(6) Other?			

C. Gates and Tower

(1) Gates:			
a. Size: Operating:	Emergency:		
b. Type: Operating:	Emergency:		
(2) Controls operational?			
(3) Controls lubricated?			
(4) Operational problems?			
(5) Leakage around gates?			
(6) Gate seals in good condition?			
(7) Any cavitation damage? If so, describe?			
(8) Describe air vent-size and condition.			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

C. Gates and Tower (continued)

(9) Is there a jet pump?			
a. Is it operational?			
b. Leakage?			
(10) Is the tower dry? _____ wet?			
(11) Any seepage in the tower?			
(12) Tower in good condition?			
(13) Any safety problems?			
(14) Ladder in good condition?			
(15) Gate house in good condition?			
(16) Emergency plan completed for the dam?			
a. Posted in the gatehouse?			
(17) Other?			

D. Stilling Basin

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Do energy dissipaters show:			
a. Signs of deterioration?			
b. Are they covered with debris?			
(4) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

E. Downstream Channel

(1) Is the channel:			
a. Eroding or back cutting?			
b. Sloughing?			
c. Obstructed?			
(2) Is released water:			
a. Undercutting the outlet?			
b. Eroding the embankment?			
(3) Other?			

4. SPILLWAY

A. Description

(1) Location?			
(2) Type of Spillway?			
(3) Size of Spillway?			
(4) Spillway lining?			
(5) Is there a weir?			
(6) Is the spillway in good condition?			
(7) Any drains?			
a. Describe the condition of drains.			

B. Does spillway show:

(1) Any cracking concrete?			
(2) Any spalling concrete?			
(3) Any exposed reinforcement in the concrete?			
(4) Any erosion?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

4. SPILLWAY (continued)

B. Does spillway show: (continued)

(5) Any slope sloughing?			
(6) Any obstructions?			
(7) Displacement or offset joints?			
(8) Loss of joint material?			
(9) Leakage at the joints?			
(10) Other?			

C. Do the energy dissipaters show:

(1) Signs of deterioration?			
(2) Any cracking?			
(3) Any spalling?			
(4) Any exposed reinforcement?			
(5) Are they covered with debris?			
(6) Other?			

D. Has release water:

(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Eroded the downstream channel?			
(4) Other?			

E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)

ITEM	YES	NO	REMARKS
------	-----	----	---------

5. RESERVOIR CONTROL

A) Recent upstream development?			
B) Recent downstream development?			
C) Slides in reservoir area?			
D) Change in reservoir operation?			
E) Large impoundment upstream?			
F) Any debris in the reservoir?			
G) Other?			

6. INSTRUMENTATION

A) List type(s) of instrumentation:.			
B) In good condition?			
C) Read periodically?			
D) Is data available?			
E) Include all data gathered since last report.			

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

--

This dam was inspected by:

Additional comments and recommendations.

APPENDIX C
MONITORING WELL LOGS



SOIL LOG OF BOREHOLE NO: DH1

(Page 1 of 2)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : YELLOWATER
DATE STARTED : 10/8/2004
DATE COMPLETED : 10/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3126.0	Sample Interval	SAMPLER TYPE SS Split spoon SL Split Spoon Brass Liners ST Shelby Tube	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
0	3126		0 to 1' ROAD BASE gravelly, dry	GP								
5	3121	X	2 to 42' LEAN CLAY, with sand, stiff, brown, slightly moist to moist, med. plasticity, w/ small amount of organics			SS	4 6 7	13	17/18	94%		
10	3116	X				SL	4 7 12	16	18/18	100%	4.0	At 10 to 11.5' Finer #200 = 85% Dry unit wt. = 102 pcf, m = 18.1% LL=33%, PL=15%, PI=18% TV=2.3 tsf
15	3111	X		CL		SS	3 5 6	11	17/18	94%		
20	3106	X	Slightly moist			SL	5 7 12	16	18/18	100%	4.5	At 20 to 21.5' Finer #200 = 80% Dry unit wt. = 112.6 pcf, m = 17.3% LL=34%, PL=14%, PI=20% Pinhole=ND Tv=2.3 tsf
25	3101	X				ST			24/24	100%		At 25 to 27' Finer #200 = 95% LL=38%, PL=16%, PI=22% Dry unit wt. = 106.8 pcf, m = 19.3% CU test: C=3.87psi, phi=15.1 C=1.97psi, phi=27.9
30												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"



SOIL LOG OF BOREHOLE NO: DH1

(Page 2 of 2)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : YELLOWATER
DATE STARTED : 10/8/2004
DATE COMPLETED : 10/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : 3K-66
DRILLING METHOD : Hollow-stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3126.0	Sample Interval	SAMPLER TYPE		USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS	
			SS Split spoon	SL Split Spoon Brass Liners										ST Shelby Tube
30	3096	<div><div></div><div></div><div></div></div>			CL	<div><div></div><div></div><div></div></div>	SL	4 5 6 3 5 7	11	18/18	100%	0.75	Tv=0.6 tsf At 35 to 36.5' Finer #200 = 81% LL=37%, PL=16%, PI=21%	
		<div><div></div><div></div><div></div></div>					SS	5 6 7	12	18/18	100%			
35	3091	<div><div></div><div></div><div></div></div>					SS	4 6 8	14	18/18	100%			
40	3086	<div><div></div><div></div><div></div></div>	At 40 to 41.5' clay, augered fairly easily, decomposed shale		SH	<div><div></div><div></div><div></div></div>	SS	6 11 21	32	18/18	100%		standing water at 45'	
45	3081	<div><div></div><div></div><div></div></div>	At 42 to 55' SHALE, decomposed shale from 42' to 45', more competent from 45' to bottom of hole (55'); shale is black, with thin laminae				SL	10 21 30	45	18/18	100%			
50	3076	<div><div></div><div></div><div></div></div>					SS	25 50+		10.5/10.5	100%			
55	3071	<div><div></div><div></div><div></div></div>	55' BOTTOM OF HOLE				SS	34 50+	6.5/6.5	100%				
60														

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"



WELL COMPLETION LOG NO: DH1

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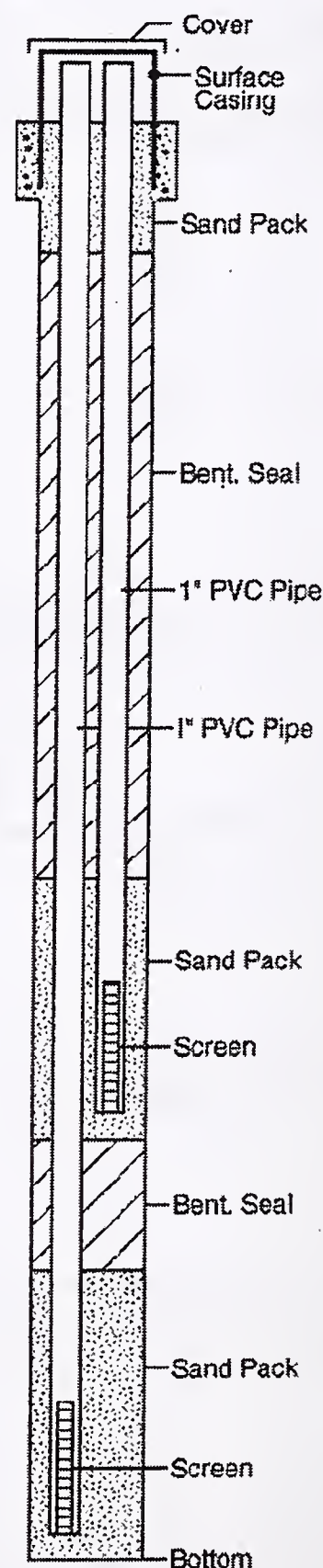
MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : Yellowwater
DATE STARTED : 10/8/2004
DATE COMPLETED : 10/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erhman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 3126.0	Well Construction Information	DESCRIPTION	Depth In Feet
0	3126	WELL CONSTRUCTION Date Compl. : 10/8/2004 Hole Diameter : 6 inch DNRC Rep. : Bob Arrington	0 to 5 SAND	0
5	3121	STANDPIPE Material : PVC pipe Diameter : 1 inch Joints : screwed Bottom Cap : glued	5 to 29 BENTONITE	5
10	3116	WELL SCREEN Material : PVC pipe Diameter : 1 inch Length : 5 feet Opening : .02 inch		10
15	3111	SAND PACK Material : Colorado Silica 10/20		15
20	3106	ANNULUS Material : 3/8 inch Bentonite		20
25	3101	WELL COVER Size : 4" x 4" square Length : 5 feet		25
30	3096	NOTES: Surface Elev. 3126.0 feet	29 to 39 SAND	30
35	3091	DH1D TOP Elev. 3128.3 feet (estimate) DH1S TOP Elev. 3128.4 feet (estimate)	33 to 38 DH1S SCREEN	35
40	3086	Top of Cover Elev. 3128.5 feet (estimate) Northing: ?? Easting: ??	39 to 44 BENTONITE 42 BEDROCK -- Shale	40
45	3081	Surveyed By: Date Surveyed:	44 to 55 SAND	45
50	3076		49 to 54 DH1D SCREEN	50
55	3071		55 BOTTOM OF HOLE	55
60				60

Well1: DH-1D
Well2: DH-1S



10-20-2004 G:\WATER_RT\WRS-STAF\Bob Arrington\Yellowwater\Yellowwater DH-1 WC.bor



SOIL LOG OF BOREHOLE NO: DH2

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MT DEPARTMENT OF NATURAL
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Helena, MT 59601-1601
(406) 444-6646

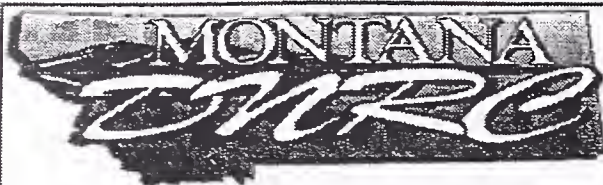
RESERVOIR : YELLOWATER
DATE STARTED : 10/8/2004
DATE COMPLETED : 10/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3089.0	Sample Interval	SAMPLER TYPE SS Split spoon SL Split Spoon Brass Liners ST Shelby Tube	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recovered Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
0	3089		0 to 8.5' CLAYEY SAND, brown, moist to wet, organics									
5	3084	X	Water surface at 4'	SC		SS	2 1 2	3	5/18	28%		At 5 to 6.5' clayey sand Finer #200 = 26%, gravel = 30% LL=22%, PL=14%, PI=8%
10	3079	X	At 8.5 to 15' CLAYEY GRAVEL, (decomposed shale), dark gray-brown, moist to wet	GC		SL	4 8 9	14	18/18	100%		
15	3074	X	At 15 to 40' SHALE, w/ thin laminae, dark gray. 15' to 18' crumbles easily, 18' to 40' competent and fresher			SS	13 25 34	59	18/18	100%		At 15 to 16.5' Cored 15 to 20', recovery = 83%, RQD = 48%
20	3069			SH								Cored 25 to 30', recovery = 100%, RQD = 80%, 2-4 frac/ft
25	3064											Cored 25 to 30', recovery = 90%, RQD = 70%, 8 frac/5ft
30			At 30 to 31.5', numerous fractures									

Hammer 140 lbs 30' drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

01-26-2006 YELLOWATER_PRRPROJECTS\Bob Arrington\Logs\Yellowwater\Yellowwater DH-2 Soil Log



SOIL LOG OF BOREHOLE NO: DH2

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MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATIONP.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : YELLOWATER

DATE STARTED : 10/8/2004

DATE COMPLETED : 10/9/2004

DRILL COMPANY : Ruan Drilling

DRILLER : Jim Erdman

DRILL RIG : BK-66

DRILLING METHOD : Hollow-stem Auger

SAMPLING METHOD : Split Spoon

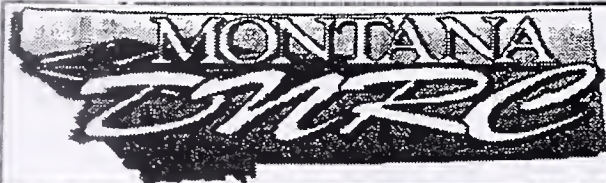
LOGGED BY : Bob Arrington

APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3089.0	Sample Interval	SAMPLER TYPE	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recovered Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
			DESCRIPTION									
30	3059											Cored 30 to 35', dark gray shale, recovery = 100%, RQD = 77%,
35	3054			SH								Cored 35 to 40', recovery = 97%, RQD = 87%, 8 frax'5ft
40	3049		40' BOTTOM OF HOLE									
45	3044											
50	3039											
55	3034											
60												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

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WELL COMPLETION LOG NO: DH2

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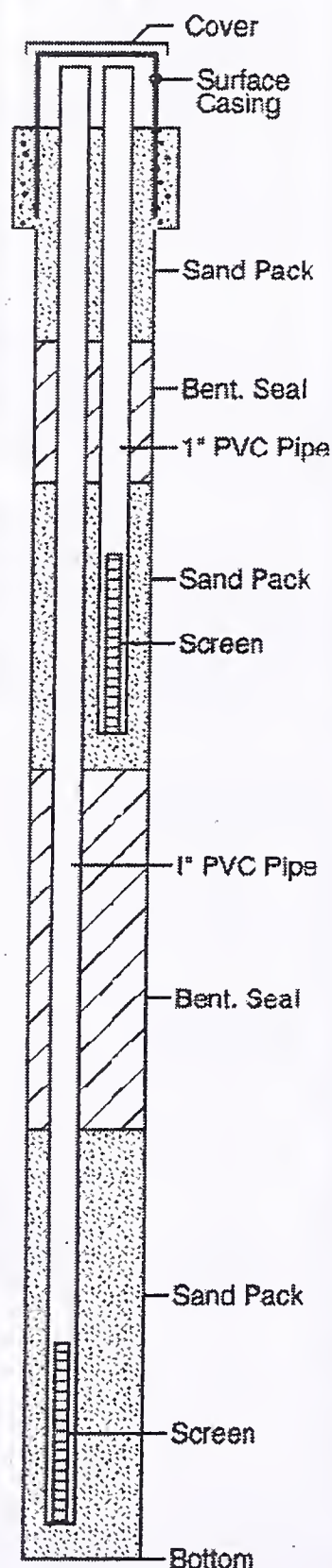
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Helena, MT 59601-1601
(406) 444-6646

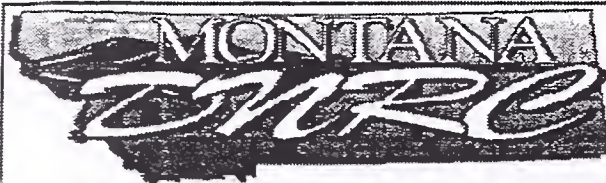
RESERVOIR : Yellowwater
DATE STARTED : 10/7/2004
DATE COMPLETED : 10/7/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erhman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 3089.0	Well Construction Information	DESCRIPTION	Depth In Feet
0	3089	WELL CONSTRUCTION Date Compl. : 10/7/2004 Hole Diameter : 8 inch DNRC Rep. : Bob Arrington	0 to 6 SAND	0
5	3084	STANDPIPE Material : PVC pipe Diameter : 1 inch Joints : screwed Bottom Cap : glued	6 to 10 BENTONITE	5
10	3079	WELL SCREEN Material : PVC pipe Diameter : 1 inch Length : 5 feet Opening : .02 inch	10 to 18 SAND	10
15	3074	SAND PACK Material : Colorado Silica 10/20	12 to 17 DH2S SCREEN	15
		ANNULUS Material : 3/8 inch Bentonite	18 to 28 BENTONITE	
20	3069	WELL COVER Size : 4" x 4" square Length : 5 feet	18 BEDROCK - Shale	20
25	3064	NOTES: Surface Elev: 3089.0 feet (estimate) DH2D TOP Elev: 3091.3 feet (estimate) DH2S TOP Elev: 3091.4 feet (estimate) Top of Cover Elev: 3091.5 feet (estimate) Northing: ?? Easting: ?? Surveyed By: Date Surveyed:	28 to 40 SAND	25
30	3059		34 to 39 DH2D SCREEN	30
35	3054			35
40	3049		40 BOTTOM OF HOLE	40
45				45

Well1: DH-2D
Well2: DH-2S





SOIL LOG OF BOREHOLE NO: DH3

(Page 1 of 2)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : YELLOWATER
DATE STARTED : 10/9/2004
DATE COMPLETED : 10/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger/Core
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3106.0	Sample Interval	SAMPLER TYPE SS Split spoon SL Split Spoon Brass Liners ST Shelby Tube HQ-NW Core Barrel	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recovered Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
0	3106		0 to 4' Silty Sand	SM								
5	3101	X	4 to 22.5' SANDSTONE, fine-grained, gray-brown, w/ thin dark gray shale interlayers			SS	20 13 27	40	16/18	89%		At 4 to 5.5' weathered sandstone w/ shaley partings, very friable
10	3096	X	At 9 to 10.5' ss laminae are harder and shaley layers are darker gray to almost black			SS	14 19 29	48	18/18	100%		
15	3091			SS								At 12' switched to core from casing advance drilling; 12 to 15' recovery = 100%, RQD = 14%, 4 frax per ft, bedding dip varies from nearly horizontal to 20deg
20	3086											Cored from 15 to 20' recovery = 90%, RQD = 18% Frax/ft = >6, nearly horizontal laminae
25	3081		22.5 to 45' SHALE, dark gray, thin laminae, w/ scattered thin alternating layers of lt. gray, fine-grained sandstone	SH								Cored from 20 to 25' Recovery = 100%, RQD = 47% Frax / ft = 6, upper 2.5' mostly ss, lower 2.5' mostly shale
30												Cored from 25 to 30' laminated shale; recovery 100%, RQD = 60%, Frax/ft = 5

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

01-26-2006 K:\WATER_P\PROJECTS\Bob A\Well Logs\Yellowater\Yellowater DH-3 Soil.dwg



SOIL LOG OF BOREHOLE NO: DH3

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MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6346

RESERVOIR : YELLOWATER
DATE STARTED : 10/9/2004
DATE COMPLETED : 10/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger/Core
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3108.0	Sample Interval	SAMPLER TYPE	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
			DESCRIPTION									
30	3076		SS Split spoon SL Split Spoon Brass Liners ST Shelby Tube HQ-NW Core Barrel									Cored from 30 to 35' laminated shale, recovery = 100%, RQD = 55%, Frax/ft = 2 to 4 most frax along laminae, minor frax at 45deg to core axis
35	3071			SH								Cored from 35 to 40' black shale, recovery = 100%, RQD = 45%, Frax/ft = 3-5, Frax horiz. and some at 45deg to core axis
40	3066											Cored from 40 to 45' lt gry to black shale w/sparse ss interlayers, recovery = 100%. RQD = 62%, Frax/ft = 3 .
45	3061		45' BOTTOM OF HOLE									
50	3056											
55	3051											
60												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

01-26-2008 \\WATER_P\PROJECTS\Bob AI\Well Logs\Yellowwater\Yellowwater DH-3 Soil.bor



WELL COMPLETION LOG NO: DH3

(Page 1 of 1)

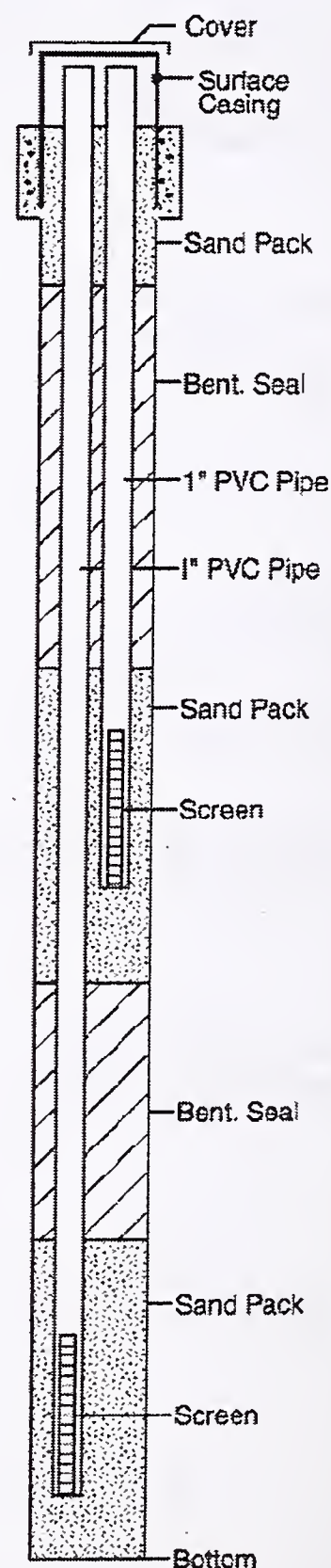
MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : Yellowwater
DATE STARTED : 10/9/2004
DATE COMPLETED : 10/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erhman

DRILL RIG : BK-66
DRILLING METHOD : HW Case Advance/Core
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 3110.0	Well Construction Information	DESCRIPTION	Depth In Feet
0	3110	WELL CONSTRUCTION Date Compl. : 10/9/2004 Hole Diameter : 4.25 inch DNRC Rep. : Craig Stiles	0 to 5 SAND	0
5	3105	STANDPIPE Material : PVC pipe Diameter : 1 inch Joints : screwed Bottom Cap : glued	5 to 17 BENTONITE	5
10	3100	WELL SCREEN Material : PVC pipe Diameter : 1 inch Length : 5 feet Opening : .02 inch		10
15	3095	SAND PACK Material : Colorado Silica 10/20	17 to 27 SAND	15
20	3090	ANNULUS Material : 3/8 inch Bentonite	19 to 24 DH3S SCREEN	20
25	3085	WELL COVER Size : 4" x 4" square Length : 5 foot	26 Bedrock -- Shale	25
30	3080	NOTES: Surface Elev: 3110.0 feet (estimate) DH3D TOP Elev: 3112.3 feet (estimate) DH3S TOP Elev: 3112.4 feet (estimate) Top of Cover Elev: 3112.5 feet (estimate)	27 to 35 BENTONITE	30
35	3075	Northing: ?? Easting: ?? Surveyed By:	35 to 45 SAND	35
40	3070	Date Surveyed:	38 to 43 DH3D SCREEN	40
45	3065			45
50				50

Well1: DH-3D
Well2: DH-3S





SOIL LOG OF BOREHOLE NO: DH4

(Page 1 of 2)

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RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

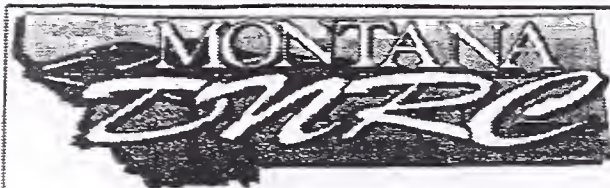
RESERVOIR : YELLOWATER
DATE STARTED : 10/10/2004
DATE COMPLETED : 10/10/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3126.0	Sample Interval	SAMPLER TYPE SS Split spoon SL Split Spoon Brass Liners ST Shelby Tube	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recovered Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
			DESCRIPTION									
0	3126		0 to 2.5' ROAD BASE, gravelly, dry	GP								
			2.5 to 47.5' LEAN CLAY									
5	3121	<input checked="" type="checkbox"/>	At 5 to 6.5' brown, med. plasticity, some organics			SS	3 6 5	11	15/18	83%		
10	3116	<input checked="" type="checkbox"/>	At 1- to 11.5' dark brown, some organics, spoon sank 6" when set in bottom of hole			SL	3 5 6	9	18/18	100%	1	At 10 to 11.5 Finer #200 = 90% LL=35%, PL=16%, PI=19% Double Hydr.Dispersion = 11% TV=0.75
15	3111	<input checked="" type="checkbox"/>	At 15 to 16.5' dark brown, slightly sandy, some organics, stiff	CL		SS	3 7 6	13	18/18	100%		
20	3106	<input checked="" type="checkbox"/>	At 20 to 21.5 black, strongly organic, stiff, some sand			SL	3 5 6	9	18/18	100%	1.5	TV=0.6 tsf
25	3101	<input checked="" type="checkbox"/>	At 25 to 26.5 dark brown, stiff, moist, some sand, wet at 28'			SS	1 3 5	8	18/18	100%		At 25 to 26.5' Finer #200=86% clay=40% LL=32%, PL=16%, PI=16%
30												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

01-26-2006 \\WATERL\PROJECTS\Bob AW\Well Logs\Yellowater\Yellowater DH-4 Soil.log



SOIL LOG OF BOREHOLE NO: DH4

(Page 2 of 2)

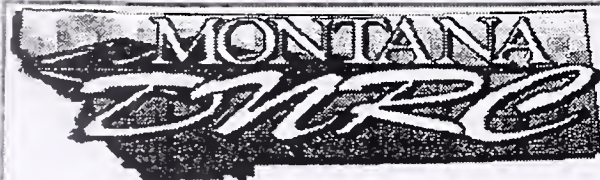
MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : YELLOWATER
DATE STARTED : 10/10/2004
DATE COMPLETED : 10/10/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3126.0	Sample Interval	SAMPLER TYPE SS Split spoon SL Split Spoon Braes Liners ST Shelby Tube	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recovered Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
30	3096	X	At 30 to 32 Shelby Tube pushed easily for 2'			ST			20/24	83%		
35	3091	X	At 35 to 36.5 dark brown, moist, some organics, SL settled 6 to 8" when set in ground	CL		SL	0 4 8	10	18/18	100%	1.25	TV=0.7tsf
40	3086	X	At 40 to 41.5 dark brown, stiff, some organics, moist, sampler settled as above			SS	4 6 8	14	18/18	100%		At 40 to 41.5' Finer#200=86% LL=35%, PL=15%, PI=20%
45	3081	X	At 45 to 46.5' Hit water at 45' dark brown, moist, some organics			SL	4 5 6	9	18/18	100%	0.5	TV=0.5tsf
50	3076	X	47.5 to 53' CLAYEY SAND brown, wet, with some gravel	SC		SL	0 3 5	7	18/18	100%		At 50 to 51.5' Finer #200 = 42% %gravel=23%, %clay=21% LL=24%, PL=14%, PI=10% Dry Unit Wt = 107.5 pcf, m=20.6%
55	3071	X	At 53' SHALE BEDROCK dark grey to black, weathered	SH								
		X	55' BOTTOM OF HOLE			SS	17 50+	50+	12/12	100%		
60												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"



WELL COMPLETION LOG NO: DH4

(Page 1 of 1)

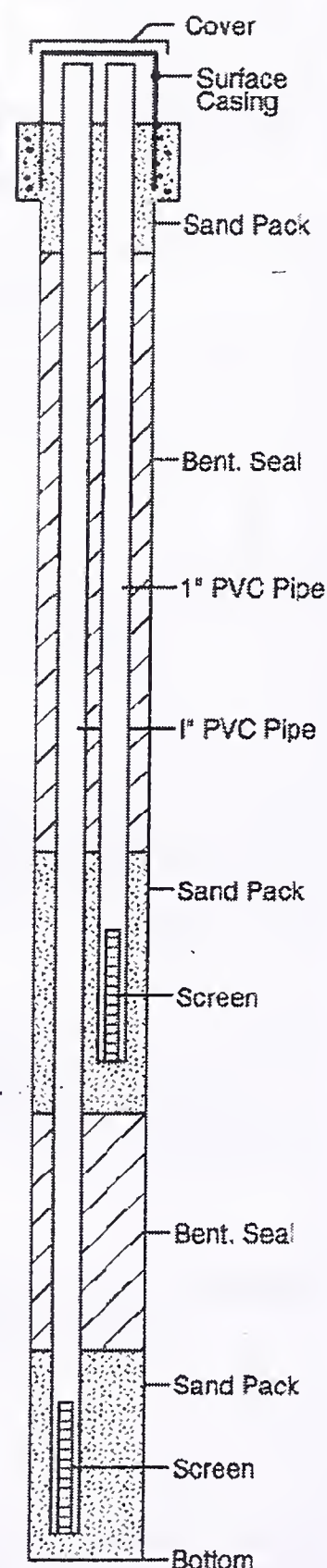
MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

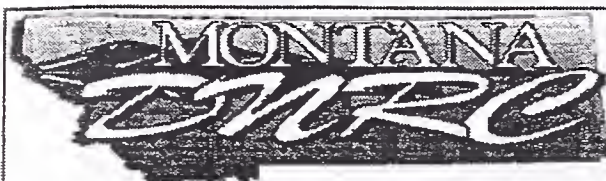
RESERVOIR : Yellowwater
DATE STARTED : 10/10/2004
DATE COMPLETED : 10/10/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Ehnman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 3126.0	Well Construction Information	DESCRIPTION	Depth In Feet
0	3126	WELL CONSTRUCTION Date Compl. : 10/10/2004 Hole Diameter : 8 inch DNRC Rep. : Craig Stiles	0 to 5 SAND	0
5	3121	STANDPIPE Material : PVC pipe Diameter : 1 inch Joints : screwed Bottom Cap : glued	5 to 28 BENTONITE	5
10	3116	WELL SCREEN Material : PVC pipe Diameter : 1 inch Length : 5 feet Opening : .02 inch		10
20	3106	SAND PACK Material : Colorado Silica 10/20		20
25	3101	ANNULUS Material : 3/8 inch Bentonite		25
30	3096	WELL COVER Size : 4" x 4" square Length : 5 feet	28 to 38 SAND	30
35	3091	NOTES: Surface Elev: 3126.0 feet DH4D TOP Elev: 3128.3 feet (estimate) DH4S TOP Elev: 3128.4 feet (estimate) Top of Cover Elev: 3128.5 feet (estimate) Northing: ?? Easting: ?? Surveyed By: Date Surveyed:	31 to 36 DH4S SCREEN	35
40	3086		38 to 47 BENTONITE	40
45	3081		47 to 55 SAND	45
50	3076		49 to 54 DH4D SCREEN	50
55	3071		55 BOTTOM OF HOLE	55
60				60

Well1: DH-4D
Well2: DH-4S





SOIL LOG OF BOREHOLE NO: DH5

(Page 1 of 2)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : YELLOWATER
DATE STARTED : 10/11/2004
DATE COMPLETED : 10/12/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3126.0	Sample Interval	SAMPLER TYPE SS Split spoon SL Split Spoon Brass Liners ST Shelby Tube	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recovered Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
			DESCRIPTION									
0	3126		0 to 3' ROAD BASE, gravelly, dry	GP								
			3 to 47' LEAN CLAY									
5	3121	<input checked="" type="checkbox"/>	At 5 to 6.5' brown, dry			SS	5 6 7	13	17/18	94%		
10	3116	<input checked="" type="checkbox"/>	At 10 to 11.5 brown, some organics			SL	5 14 21	29	17/18	94%	1	At 10 to 11.5 Finer #200 = 89% LL=35%, PL=16%, PI=19% Dry Unit Wt. = 103.3 pcf, m=15% TV = 0.2 tsf
15	3111	<input checked="" type="checkbox"/>	At 15 to 16.5' brown, crumbly, some organics	CL		SS	3 6 10	16	14/18	100%		
20	3106	<input checked="" type="checkbox"/>	At 20 to 21.5 black, strongly organic, stiff, some sand			SL	3 6 10	13	18/18	100%	1.25	At 20 to 21.5 TV = 1.4 tsf Finer #200 = 86% Clay = 39% LL=36%, PL=16%, PI=20% Dry Unit Wt. = 101.6 pcf, m = 17.5%
25	3101	<input checked="" type="checkbox"/>	At 25 to 26.5 brown, moist, some sand and some organics			SS	2 4 7	11	15/18	83%		At 25 to 26.5 Finer #200 = 98% LL=44%, PL=16%, PI=28% DS Test: C=0.67 psl, phi=21.2
30												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

01-26-2006 K:\WATER_PROJECTS\Bob A\Well Log\Yellowater\Yellowater DH-5 Soil.doc



SOIL LOG OF BOREHOLE NO: DH5

(Page 2 of 2)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : YELLOWATER
DATE STARTED : 10/11/2004
DATE COMPLETED : 10/12/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow-stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth in Feet	Surf. Elev. 3126.0	Sample Interval	SAMPLER TYPE SS Split spoon SL Split Spoon Brass Liners ST Shelby Tube	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recovered Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
30	3096	<input checked="" type="checkbox"/>	At 30 to 31.5' brown to dk. brown, moist	CL		ST	1 4 8	8	18/18	100%	2.25	At 30 to 31.5' TV = 1.4 tsf Finer #200 = 87% LL=32%, PL=15%, PI=17% Dry Unit Wt. = 113.2 pcf, m = 18.1%
35	3091	<input checked="" type="checkbox"/>	At 35 to 37' Lean clay, as above			ST			22/24	92%		
40	3086	<input checked="" type="checkbox"/>	At 40 to 41.5' mottled coloration consisting of gray clayey blobs mixed with brown sandy organic fill, moist			SS	1 3 5	8	18/18	100%		
45	3081	<input checked="" type="checkbox"/>	At 45 to 46.5' Hit water at 45' Lean clay, moist gray clay with organics			SL	0 1 12	11	18/18	100%	1	At 45 to 46.5' TV=4 Finer #200 = 82%, Clay = 34% LL=33%, PL=15%, PI=18% Dry Unit Wt. = 106.2 pcf, m = 20.7%
50	3076	<input checked="" type="checkbox"/>	At 47 to 56.5' WEATHERED SHALE BEDROCK, dark gray to black	SH		SS	3 8 17	25	18/18	100%		At 50 to 51.5' Finer #200 = 42% %gravel = 23%, %clay = 21% LL=24%, PL=14%, PI=10% Dry Unit Wt = 107.5 pcf, m=20.6%
55	3071	<input checked="" type="checkbox"/>	55' BOTTOM OF HOLE At 55 to 56.5' dk. gray to black weathered shale			SS	9 18 29	47	12/12	100%		
60												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"



WELL COMPLETION LOG NO: DH5

(Page 1 of 1)

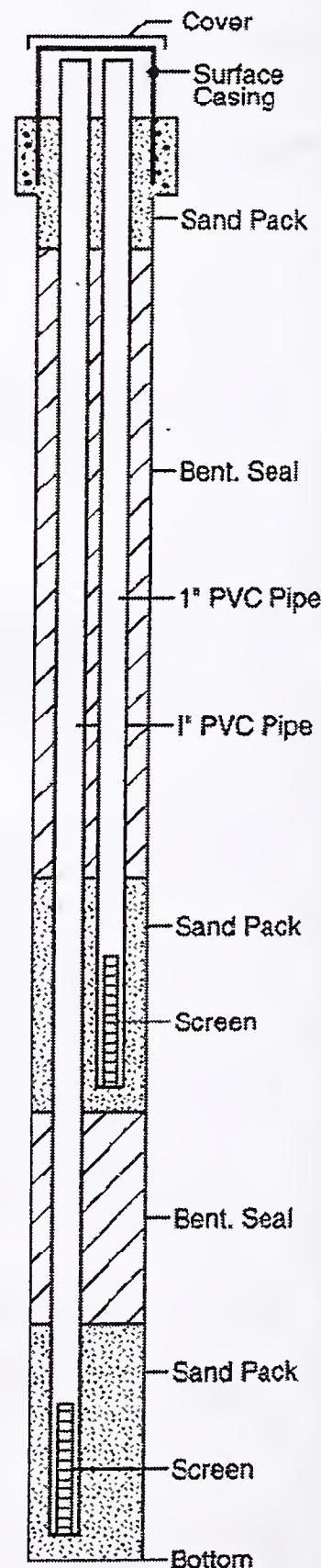
MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : Yellowwater
DATE STARTED : 10/11/2004
DATE COMPLETED : 10/12/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erhman

DRILL RIG : BK-86
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 3126.0	Well Construction Information	DESCRIPTION	Depth In Feet
0	3126	WELL CONSTRUCTION Date Compl. : 10/11/2004 Hole Diameter : 8 inch DNRC Rep. : Craig Stiles STANDPIPE Material : PVC pipe Diameter : 1 inch Joints : screwed Bottom Cap : glued WELL SCREEN Material : PVC pipe Diameter : 1 inch Length : 5 feet Opening : .02 inch SAND PACK Material : Colorado Silica 10/20 ANNULUS Material : 3/8 inch Bentonite WELL COVER Size : 4' x 4' square Length : 5 feet	0 to 5 SAND 5 to 29 BENTONITE 29 to 38 SAND 32 to 37 DH5S SCREEN 38 to 46 BENTONITE 46 to 55 SAND 49 to 54 DH5D SCREEN 55 BOTTOM OF HOLE	0
5	3121			5
10	3116			10
15	3111			15
20	3106			20
25	3101			25
30	3096	NOTES: Surface Elev: 3126.0 feet DH5D TOP Elev: 3128.3 feet (estimate) DH5S TOP Elev: 3128.4 feet (estimate) Top of Cover Elev: 3128.5 feet (estimate) Northing: ?? Easting: ?? Surveyed By: Date Surveyed:		30
35	3091			35
40	3086			40
45	3081			45
50	3076			50
55	3071			55
60				60

Well1: DH-5D
Well2: DH-5S



10-21-2004 G:\WATER_RTI\WRB-STAF\Bob A\Well Logs\Yellowwater\Yellowwater DH-5 WC.bor

APPENDIX C
DISTRUBUTION LIST

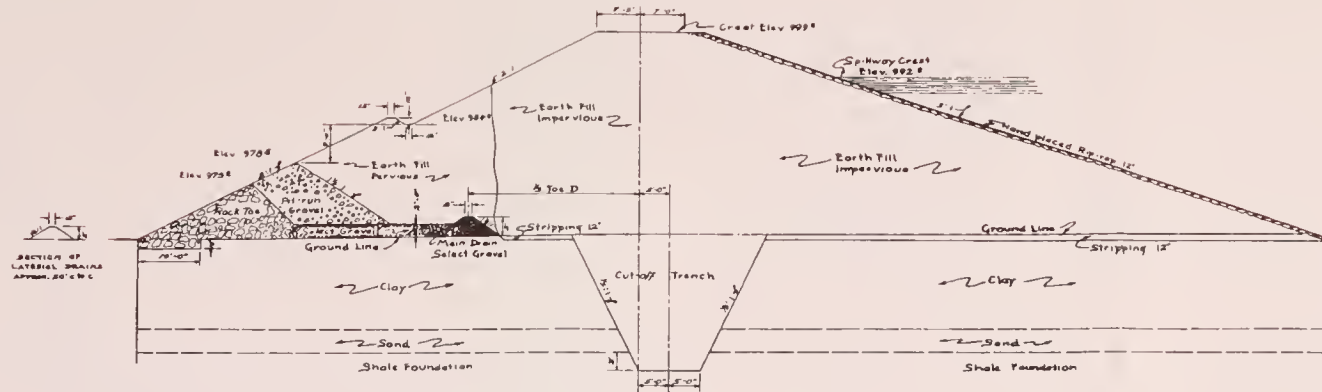
YELLOW WATER DAM O&M DISTRUBUTION LIST

	<u>Number Of Copies</u>
1. State Water Projects Bureau Bureau Chief Project Rehabilitation Section Supervisor Dam Safety Engineer (2) Instrumentation Specialist Dolores Eustice	7
2. DNRC Information Services Section	1
3. DNRC Lewistown Regional Office	2
4. DNRC Dam Safety	1
5. Yellow Water Water Users President Secretary/Dam Operator Directors (2)	4
6. State Library	4
7. Extra	2
<hr/>	
TOTAL	21

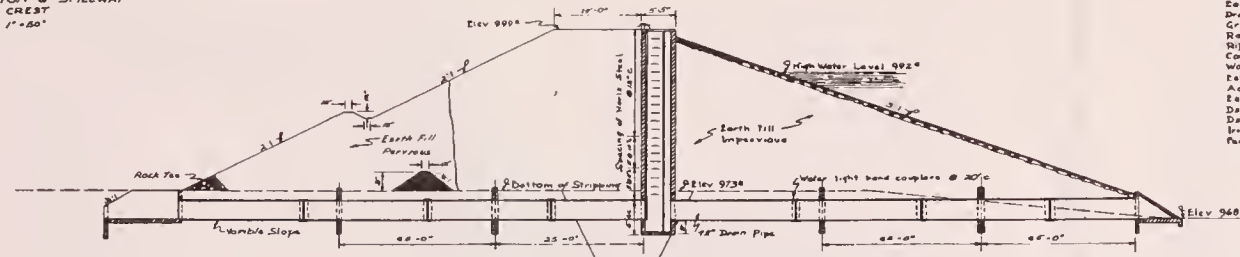
APPENDIX E

PROJECT DRAWINGS

(NOTE: Reduced project drawings E3 and E4 are design drawings and not "As Builts", and should be used for reference only. The 1985 drawings E5 through E13 are "As-Builts". The SWPB has the full size project drawings.)



MAXIMUM CROSS SECTION OF DAM
Scale 1"=10'

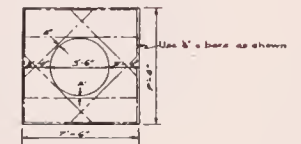


CROSS SECTION OF DAM AT OUTLET
Scale 1"=10'

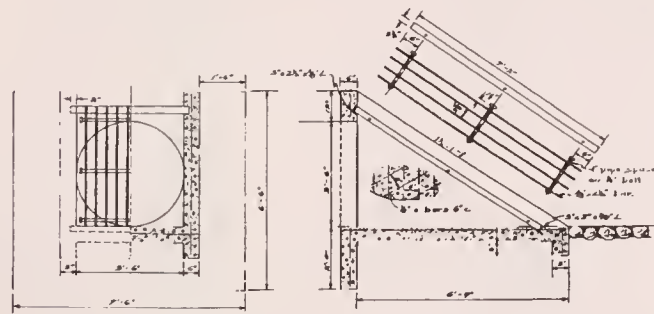
DESCRIPTION	QUANTITIES
Drainage Area	59 sq. M.
Storage	4,400 Ac. Ft.
Lake Area	430 Ac.
Flow	1800 CFS
Stripping	4,000 Cu Yds
Core Trench Exc.	12,800 "
Outlet Trench Exc.	360 "
Spillway Exc.	3,900 "
Earthfill	119,000 "
Drainage System - Gravel	930 "
Gravel Fill	9,000 "
Rip-rap rock	3,800 "
Concrete	20 "
Work Started	Nov 12, 1935
Est. Completion	Oct 1, 1936
Actual Completion	
Est. Cost	\$24.00 Ac. Ft.
Donated Material	\$5,000
Donated Equipment	\$30,000
Irrigation	2,000 Ac.
Farmers Benefited	30



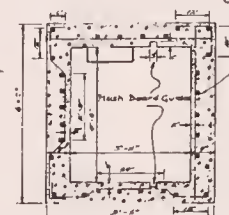
LADDER DETAIL
Scale 3/8"=1'0"



CUT-OFF DETAIL
Scale 3/8"=1'0"

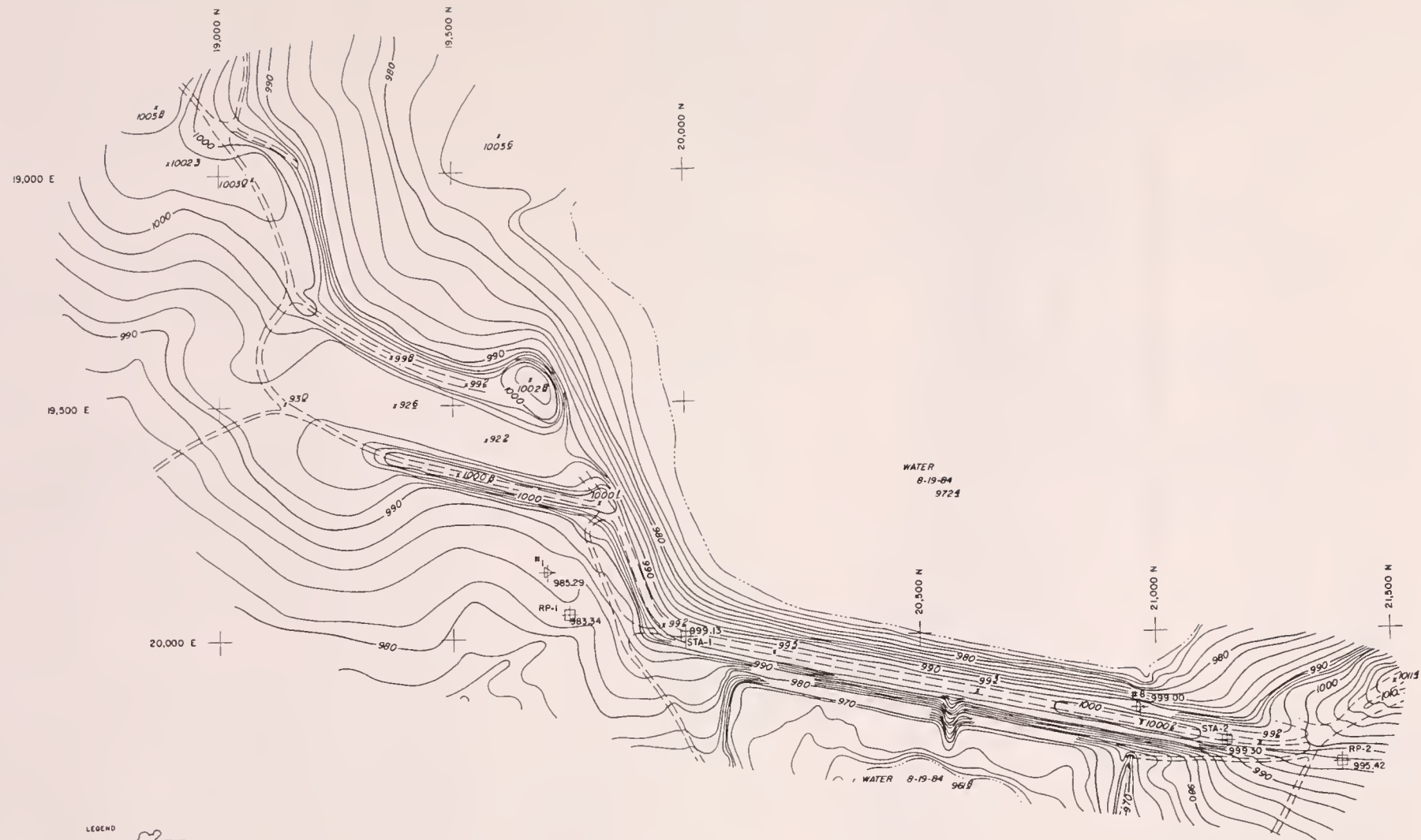


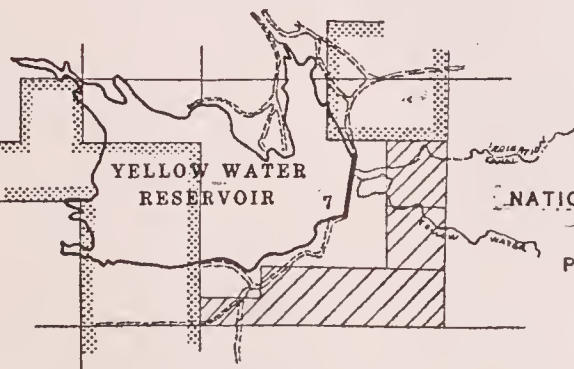
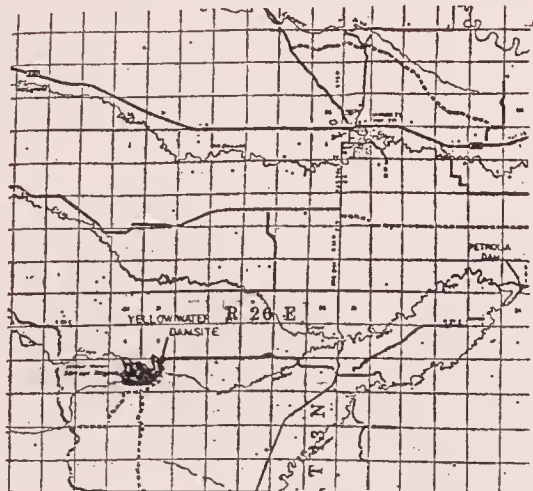
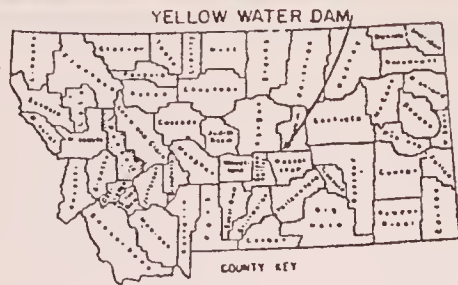
DETAILS OF INTAKE & TRASH RACK
Scale 3/8"=1'0"



SECTION THRU GATE WELL
Scale 3/8"=1'0"

SECTIONS THRU DAM YELLOW WATER STORAGE PROJECT	
DESIGNER U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE W. B. MANN, CHIEF	
LOCATION: PETROLEUM COUNTY, MONT.	
DESIGNING APPROVAL	TECHNICAL APPROVAL
DATE: MAY 23, 1936	DATE: MAY 23, 1936
COMPLD: J. L. S.	ENCLD: J. L. S.
FILE NO. P-415	





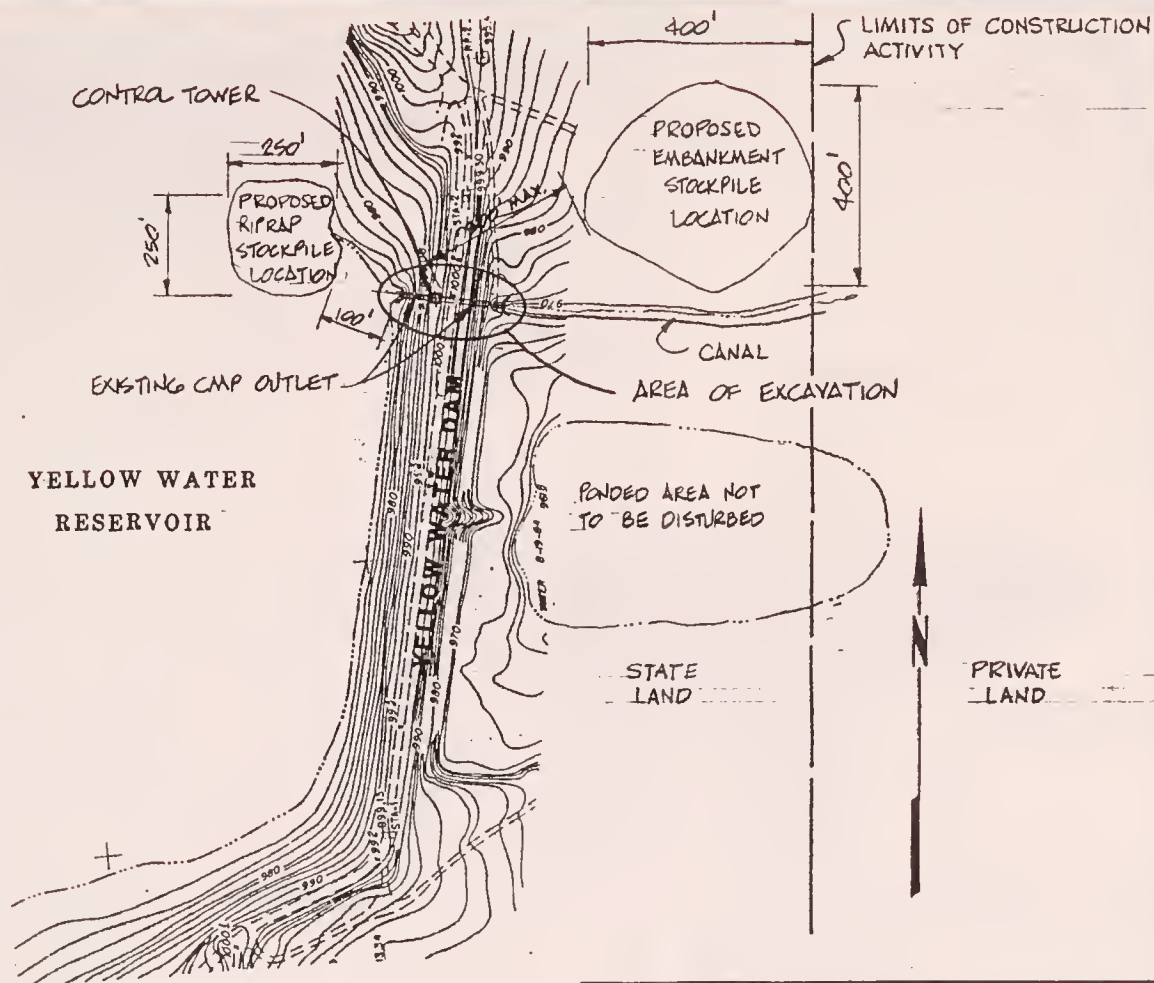
LAND OWNERSHIP MAP

LEGEND

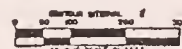
STATE LANDS
NATIONAL WILDLIFE
REFUGE LANDS
PRIVATE LANDS



INFORMATION BASED
ON PETROLEUM COUNTY FILES



SITE PLAN



DEPARTMENT OF NATURAL RESOURCES
& CONSERVATION

DNRC PROJECT NO. 166.001

YELLOW WATER DAM
OUTLET REPLACEMENT
PHASE ONE
LOCATION MAP



MORRISON-MAIERLE, INC.
CONSULTING ENGINEERS

DRAWN
JMH
DESIGNED
PPP
DATE
8-27-85
PROJECT NO.
1447-012-01
SHEET NO.

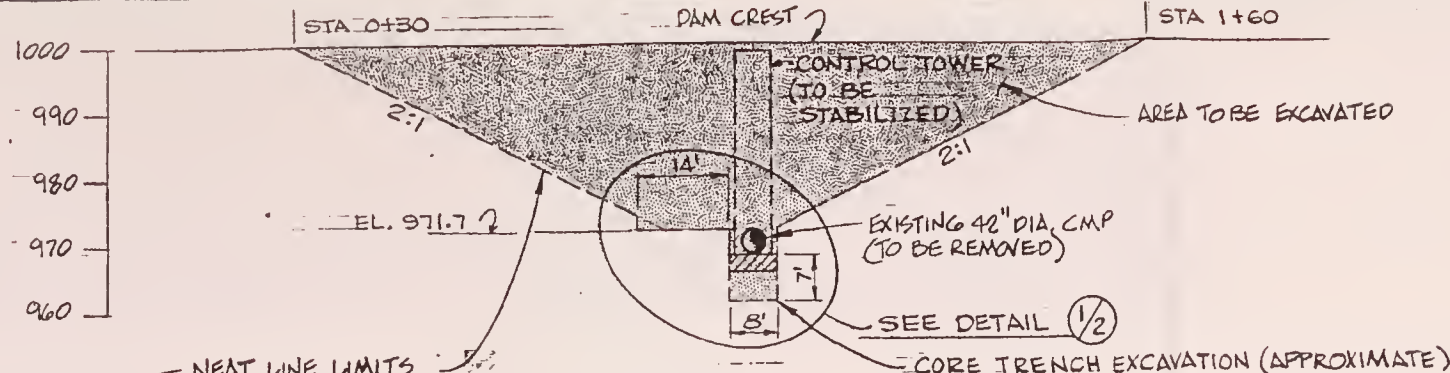
1

5-166-6

REFERENCE PIN
ELEVATIONS @

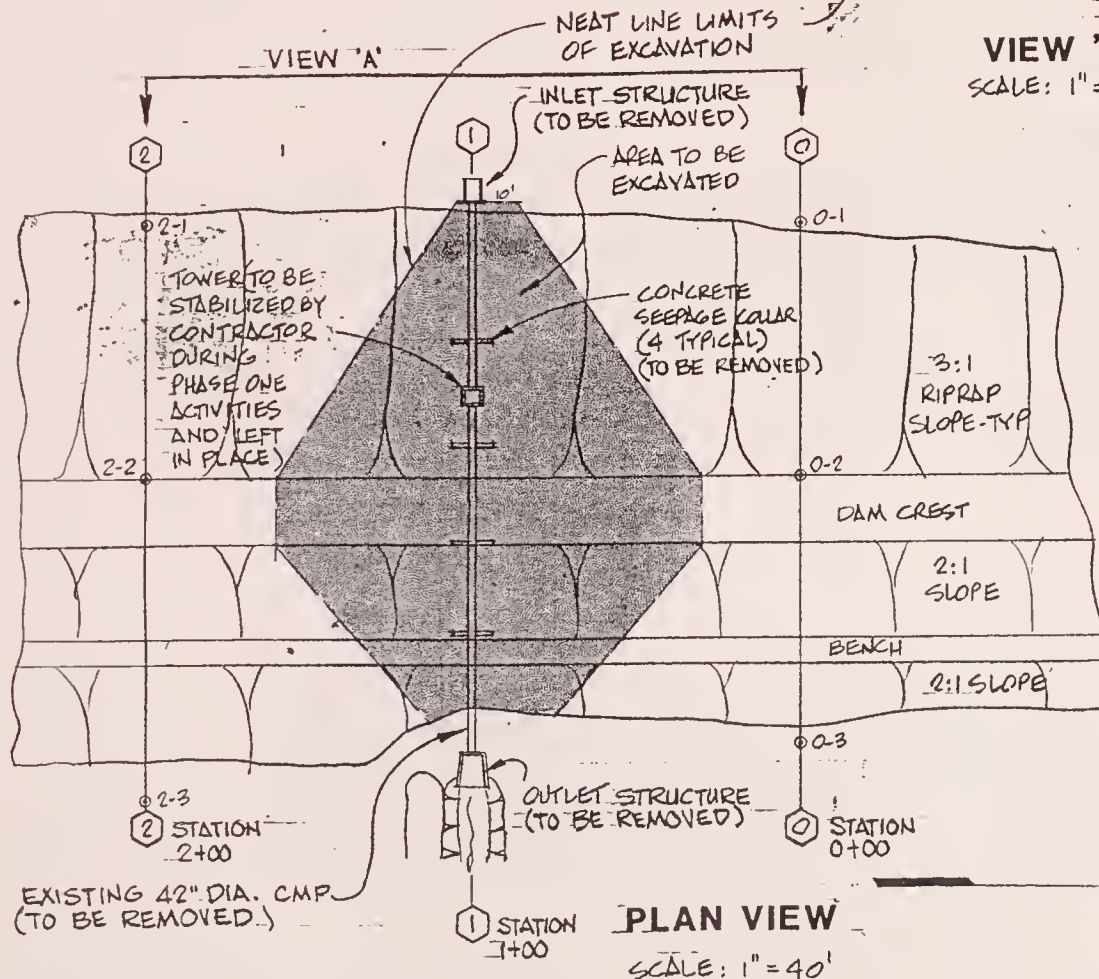
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0-2 999.63
0-3 978.99
2-1 977.11
2-2 999.19
2-3 966.99

CONTROL TOWER
ELEV. 999.00



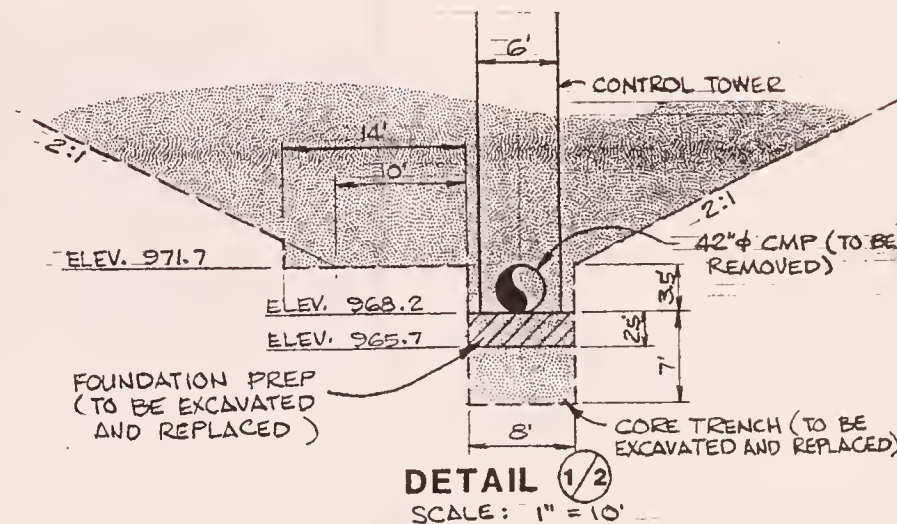
VIEW 'A'

SCALE: 1" = 20'



PLAN VIEW

SCALE: 1" = 40'



DETAIL 1/2

SCALE: 1" = 10'

DEPARTMENT OF NATURAL RESOURCES
& CONSERVATION

DNR PROJECT NO. 166.001

YELLOW WATER DAM
OUTLET REPLACEMENT
PHASE ONE

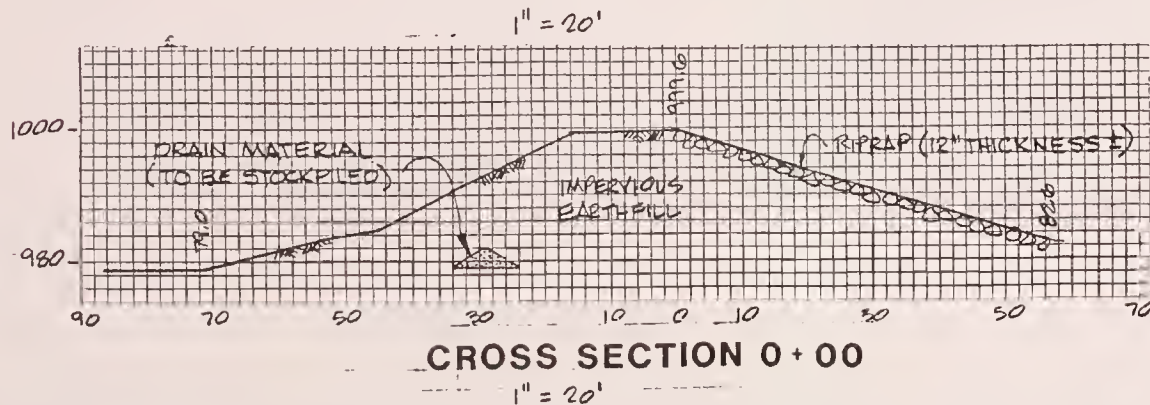
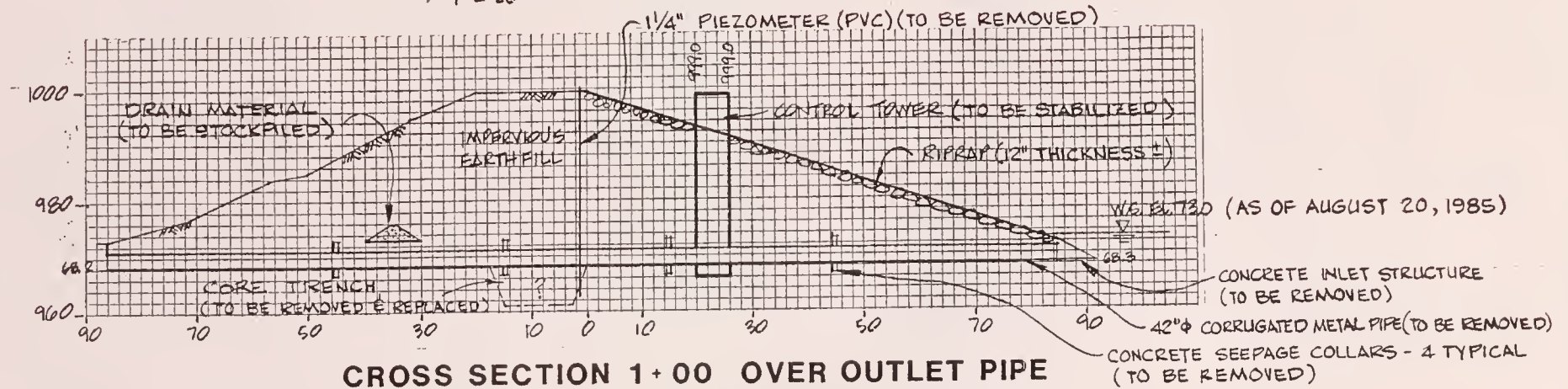
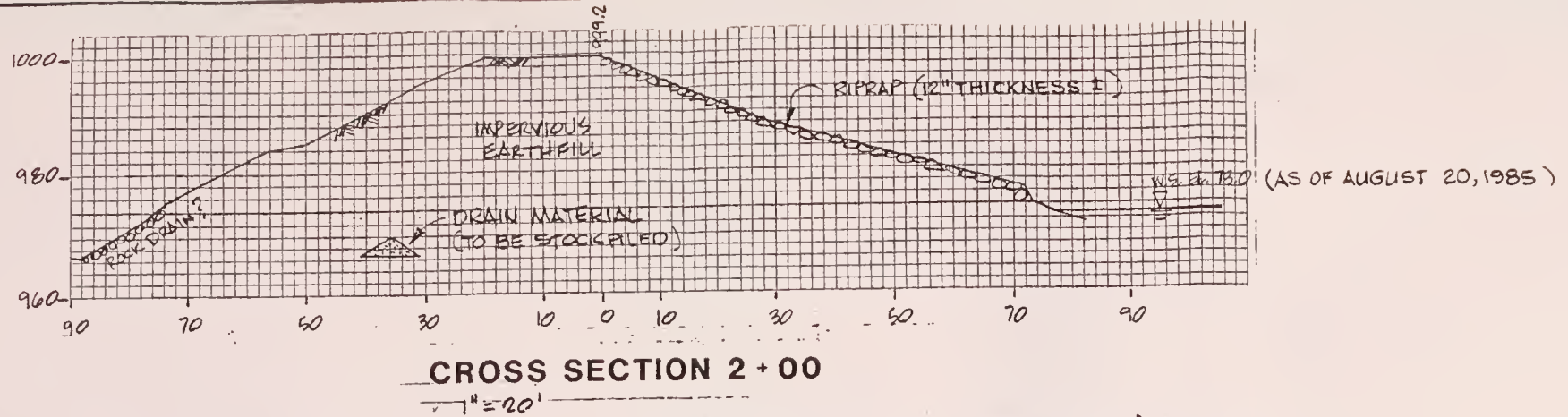
EXCAVATION VIEWS




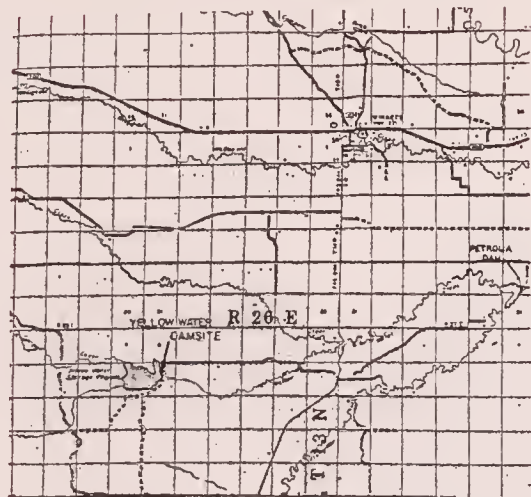
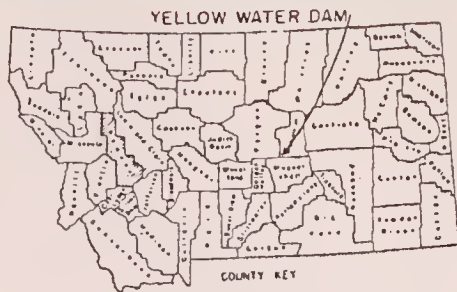
MORRISON-MAIERLE, INC.
CONSULTING ENGINEERS

DRAWN
JMH
DESIGNED
PPP
DATE
8-27-85
PROJECT NO.
1447-02-01
SHEET NO.

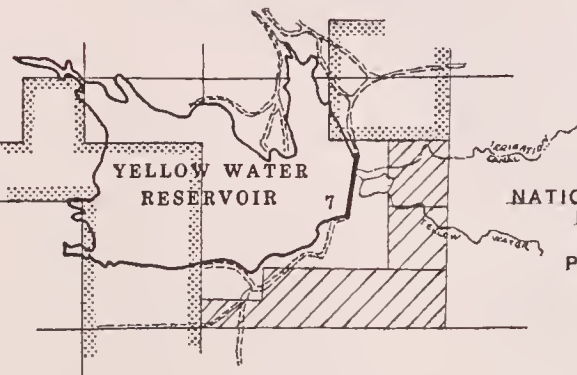
2



DEPARTMENT OF NATURAL RESOURCES & CONSERVATION DNRC PROJECT NO. 166.001		DRAWN JMH
YELLOW WATER DAM OUTLET REPLACEMENT		DESIGNED PPP
PHASE ONE CROSS SECTIONS		DATE 8-27-85
MORRISON-MAIERLE, INC. CONSULTING ENGINEERS		PROJECT NO. 1447-02-01
		SHEET NO. 3



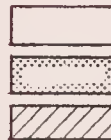
VICINITY MAP



LAND OWNERSHIP MAP

LEGEND

STATE LANDS
NATIONAL WILDLIFE
REFUGE LANDS
PRIVATE LANDS



INFORMATION BASED
ON PETROLEUM COUNTY FILES

POTENTIAL RIPRAP
SOURCE

RIPRAP STOCKPILE LOCATION

EMBANKMENT
STOCKPILE

YELLOW WATER
RESERVOIR

CONTROL TOWER

1.7 MILES

EMBANKMENT
STOCKPILE

LIMITS OF CONSTRUCTION
ACTIVITY

POTENTIAL BORROW SOURCE

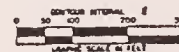
CANAL
RECONSTRUCTION AREA
ROCK TOE

PONDED AREA NOT
TO BE DISTURBED

STATE
LAND

PRIVATE
LAND

SITE PLAN



DEPARTMENT OF NATURAL RESOURCES
& CONSERVATION

DNRC PROJECT NO. 166.002

YELLOW WATER DAM
OUTLET REPLACEMENT
PHASE TWO
LOCATION MAP



MORRISON-MAIERLE, INC.
CONSULTING ENGINEERS

DRAWN
JMH
DESIGNED
PPP
DATE
9-25-05
PROJECT NO.
1447-102-01
SHEET NO.

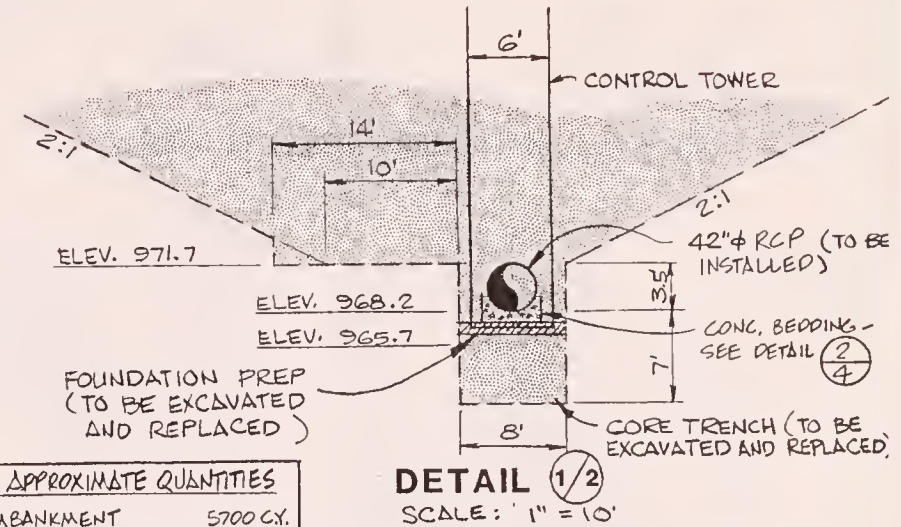
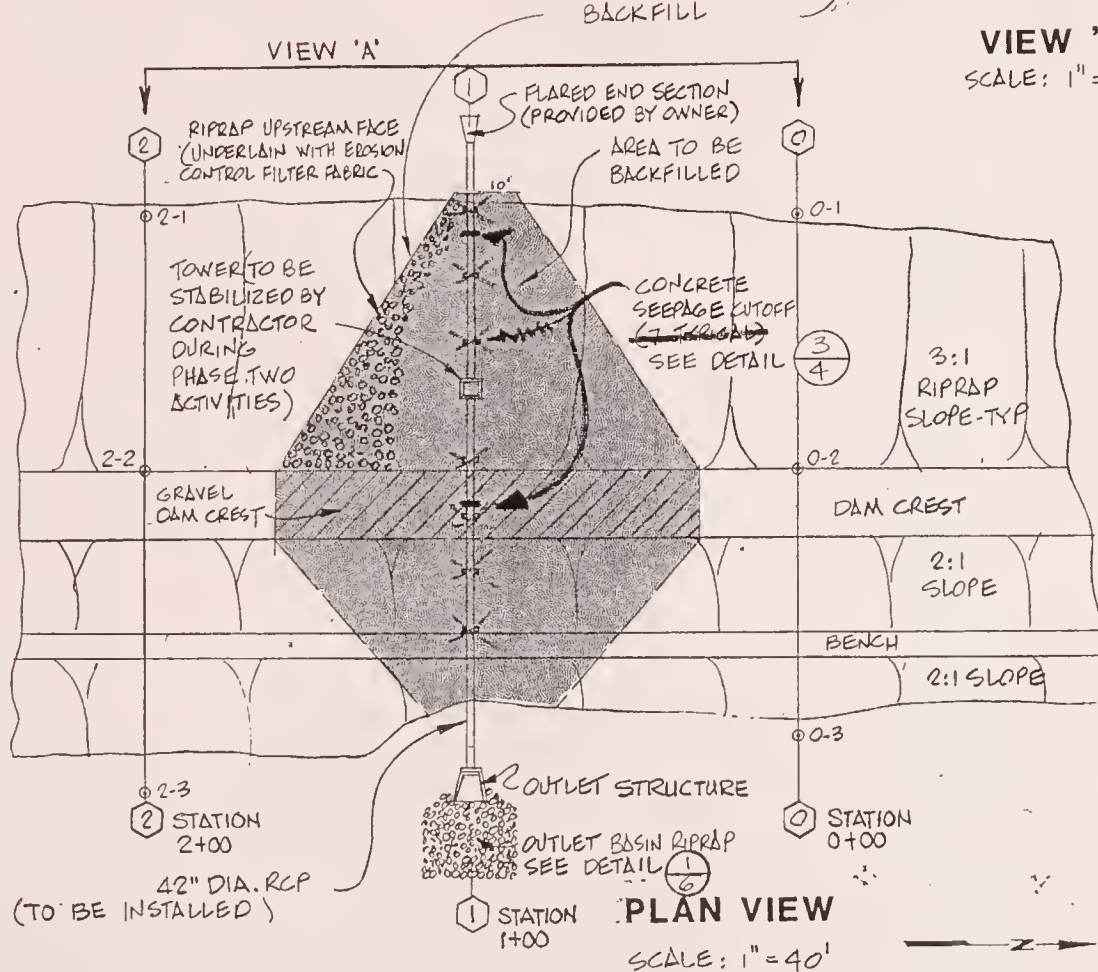
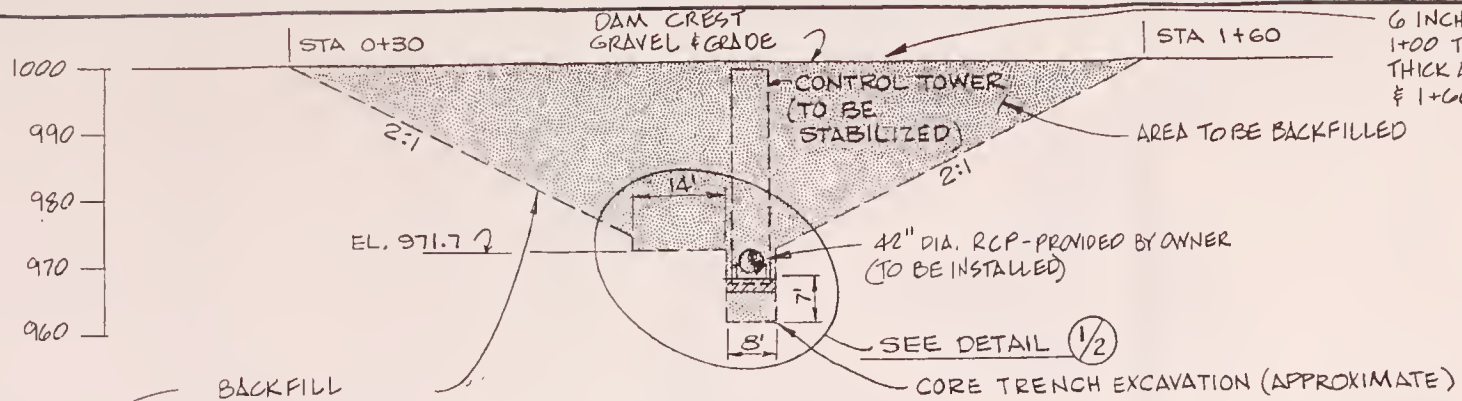
1

5-166-9

E8 2007

REFERENCE PIN ELEVATIONS

0-1	982.59
0-2	999.63
0-3	978.99
2-1	977.11
2-2	999.19
2-3	966.99
CONTROL TOWER ELEV. 999.00	



APPROXIMATE QUANTITIES

EMBANKMENT	5700 C.Y.
UPSTREAM RIPRAP	350 C.Y.
EROSION - FILTER FABRIC	1000 S.Y.
GRAVEL CREST	32 C.Y.
FOUNDATION PREP	50 C.Y.
OUTLET STRUCT.	18 C.Y.
OUTLET RIPRAP	50 C.Y.
PIPE PLACEMENT	184 FT.
PIPE BEDDING (CONC.)	45 C.Y.
CUTOFFS (CONC.)	10 C.Y.
EMBANKMENT DRAIN	1 C.Y.
PIPE DRAIN	22 C.Y.
FINISH GRADING	2 AC.
OUTLET RIPRAP BEDDING	25 C.Y.

DEPARTMENT OF NATURAL RESOURCES & CONSERVATION

DNRC PROJECT NO. 166.002

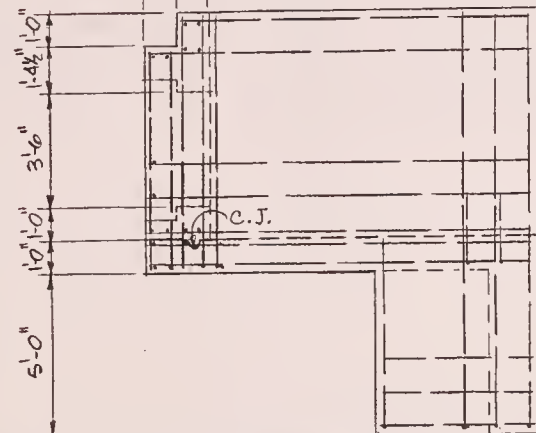
YELLOW WATER DAM OUTLET REPLACEMENT PHASE TWO

EXCAVATION VIEWS



MORRISON-MAIERLE, INC.
CONSULTING ENGINEERS

DRAWN JMH
DESIGNED PPP
DATE 9-23-85
PROJECT NO. 1447-02-0
SHEET NO. 2



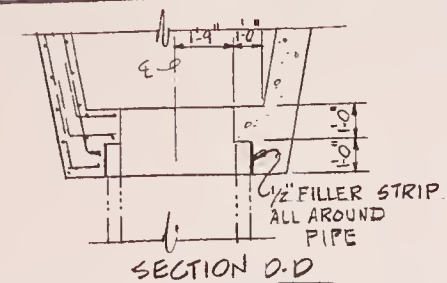
NOTE :

ELEVATION B-B

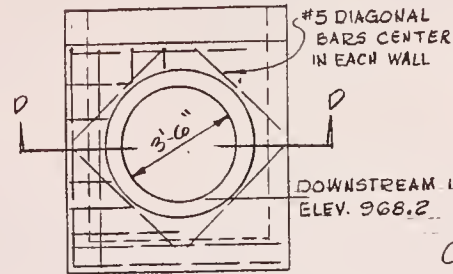
- ALL REBAR IN WALLS, FTGS.
& SLABS SHALL BE
#4 @ 12" ϕ EA. WAY
EA. FACE - GRADE GO
- PROVIDE FOR 15" LAPS
AT CONSTRUCTION JOINTS

- AT ALL WALL INTERSECTIONS
PROVIDE CORNER BARS TO
MATCH REINFORCING

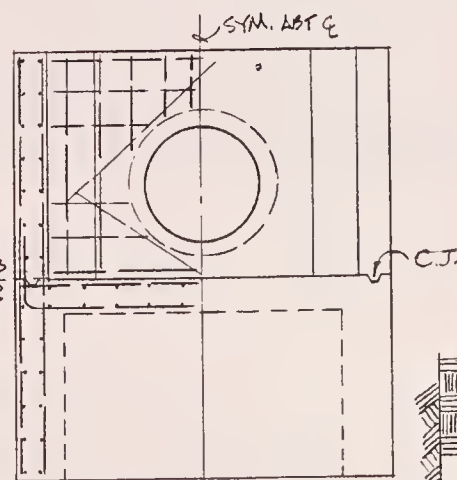
OUTLET STRUCTURE DETAILS

$$\frac{1}{4}'' = 1'-0''$$


SECTION D.D

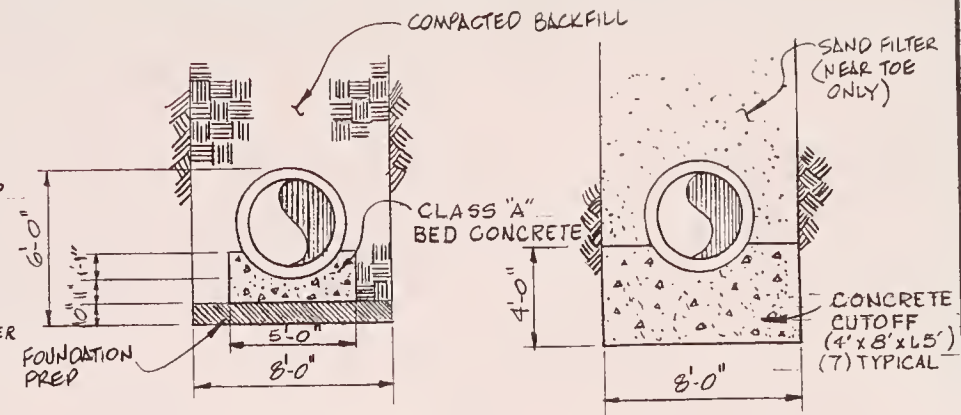


ELEVATION A-A

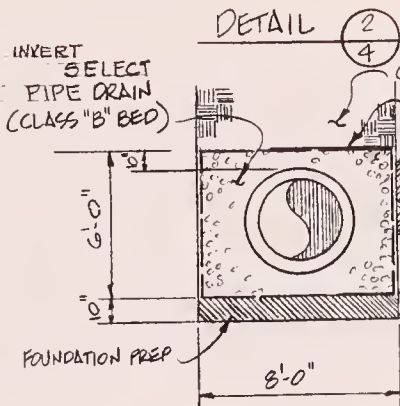


ELLVATION C-C

FOUNDATION PREP.



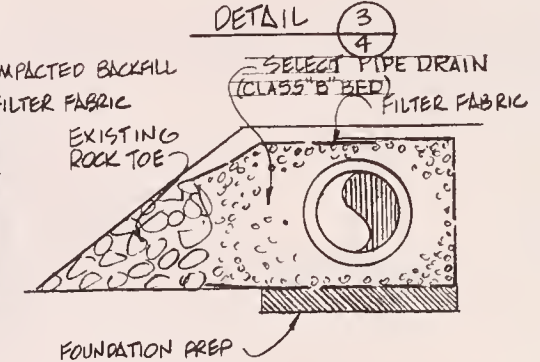
DETAIL



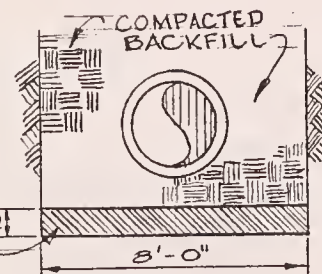
DETAIL (4)

PIPE BEDDING DETAILS
 $\frac{3}{16}'' = 1'-0''$


DETAIL (3)



DETAIL (5/4)



DETAIL

<p align="center">DEPARTMENT OF NATURAL RESOURCES & CONSERVATION</p> <p align="center">DNRC PROJECT NO. 168.002</p>	
<p align="center">YELLOW WATER DAM OUTLET REPLACEMENT PHASE TWO OUTLET STRUCTURE & PIPE BEDDING DETAILS</p>	<p align="center">DRAWN JMH</p>
	<p align="center">DESIGNED PPP</p>
	<p align="center">DATE 9-23-85</p>
	<p align="center">PROJECT NO. 447-012-01</p>
 <p align="center">MORRISON-MAIERLE, INC. CONSULTING ENGINEERS</p>	<p align="center">SHEET NO. 4</p>

SLOPE .0015 FT/FT.

OUTLET STRUCTURE
SEE DETAIL (1/4)

DOWNSTREAM INV. EL. 968.2

OUTLET BASIN
SEE DETAIL (1/6)

14 - 8'-0" SECTIONS = 112 L.F.

42" RCP - PROVIDED
BY OWNER

1- 8'-0" SECTION OF SPECIAL
PIPE TO TOWER CONNECTION

EXISTING CONC. TOWER

9 - 8'-0" SECTIONS = 72 L.F.

FIELD GROUT - TYP.

SEE PIPE JOINT DETAIL (1/5)

1- 42" FLARED END
SECTION, MALE w/
TRASH RACK PROVIDED
BY OWNER

UPSTREAM INV. EL. 968.5

DOWNSTREAM CUTOFF (1 ONLY) 42" OUTLET PIPE LAYOUT

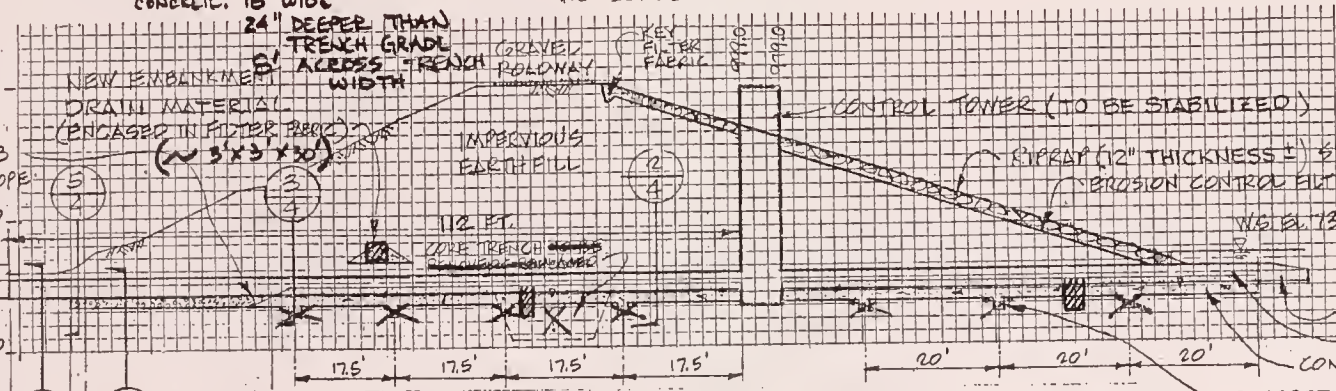
CONCRETE: 18" WIDE
NO SCALE

UPSTREAM CUTOFF (1 ONLY)

CONCRETE:
36" WIDE
24" DEEPER THAN
TRENCH GRADE
8' ACROSS
TRENCH WIDTH

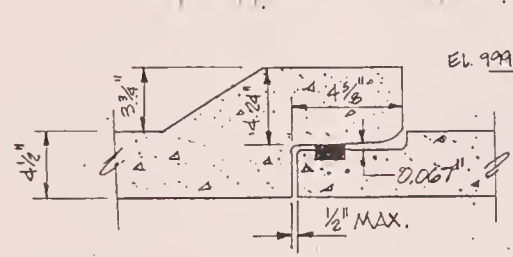
70' FROM TOWER MAKE
TRANSITION FROM CONC.
PIPE BEDDING TO CLASS B
BEDDING REQUIRES 3:1 SLOPE

OUTLET STRUCTURE
SEE DETAIL (1/4)

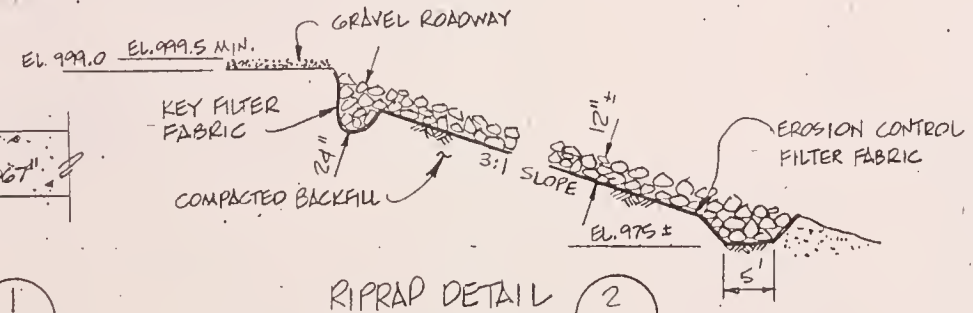


CROSS SECTION 1+00 OVER OUTLET PIPE


CONCRETE FLARED END SECTION
42" RCP
CONCRETE PIPE BEDDING SEE DETAIL (2/4)
CONCRETE SEEPAGE CUTOFF (4'x8'x1.5')
SEE DETAIL (3/4) TYP.

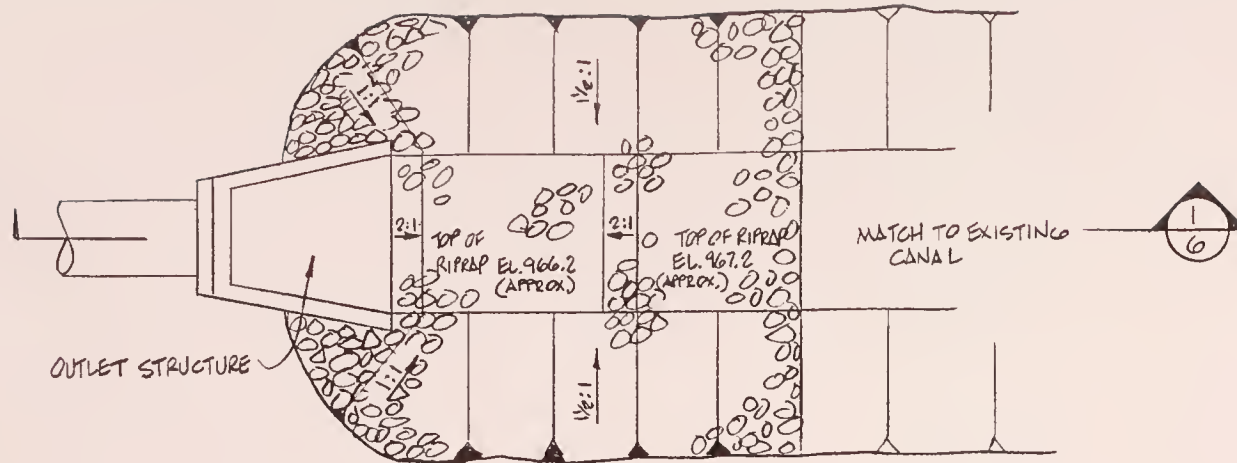


PIPE JOINT DETAIL (1/5)
N.T.S.



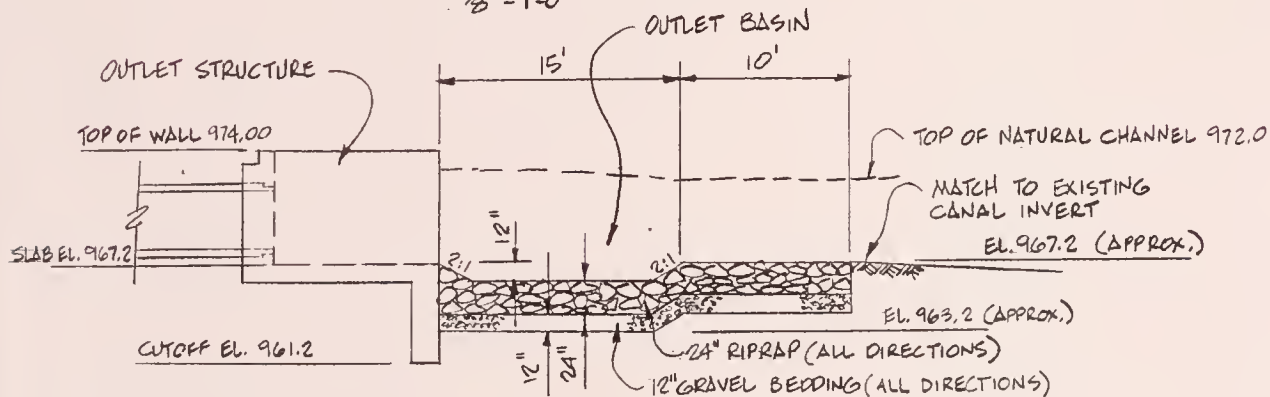
RIPRAP DETAIL (2/5)
N.T.S.

DEPARTMENT OF NATURAL RESOURCES & CONSERVATION DNRC PROJECT NO. 188.002	
YELLOW WATER DAM OUTLET REPLACEMENT PHASE TWO CROSS SECTION	
 MORRISON-MAIERLE, INC. CONSULTING ENGINEERS	DRAWN JMH
	DESIGNED PPP
	DATE 9-23-85
	PROJECT NO. 1447-012-01
SHEET NO. 5	



OUTLET BASIN PLAN

1/8" = 1'-0"



SECTION

1/8" = 1'-0"

DEPARTMENT OF NATURAL RESOURCES
& CONSERVATION

DNRC PROJECT NO. 166.001

YELLOW WATER DAM
OUTLET REPLACEMENT
PHASE TWO
OUTLET BASIN DETAILS

DRAWN
JMH
DESIGNED
PPP
DATE
9-23-85
PROJECT NO.
1447-012-01
SHEET NO.

6



MORRISON-MAIERLE, INC.
CONSULTING ENGINEERS

5-146-14

